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1918
U. S. Department of Agriculture

UNITED STATES DEPARTMENT OF AGRICULTURE
BULLETIN No. 614
OFFICE OF THE SECRETARY
Contribution from the Office of Farm Management
W. J. SPILLMAN, Chief

Washington, D. C. ▼ April 20, 1918

COST OF PRODUCING APPLES IN YAKIMA VALLEY, WASHINGTON

A DETAILED STUDY OF THE CURRENT COST FACTORS INVOLVED IN THE MAINTENANCE OF ORCHARDS AND THE HANDLING OF THE CROP ON 120 REPRESENTATIVE BEARING ORCHARDS

By
G. H. MILLER, Assistant Agriculturist, and
S. M. THOMSON, Scientific Assistant

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Total of All Costs	72

WASHINGTON
GOVERNMENT PRINTING OFFICE
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COST OF PRODUCING APPLES IN YAKIMA VALLEY, WASHINGTON.[1]

A detailed study of the current cost factors involved in the maintenance of orchards and the handling of the crop on 120 representative bearing orchards.

By G. H. Miller, *Assistant Agriculturist*, and S. M. Thomson, *Scientific Assistant.*

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INTRODUCTION.

This bulletin presents the results of a study of apple orcharding in Yakima Valley (Washington) made by the Office of Farm Management during the summer of 1915. As with previous surveys conducted in the apple-growing districts of the Northwest, the object of the study was to determine the cost factors involved in apple production, and to gather such information as to the different methods of orchard management practiced by the growers of the valley as might have a bearing upon cost of production.

Data were obtained by the same method used in Wenatchee Valley in 1914. A sufficient number of orchardists were visited to give a reliable average, and complete and detailed information was gathered regarding the usual methods of procedure in orchard management,

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[1] This is the fourth of a series of bulletins on the cost of apple production. Department Bulletin No. 446, "The Cost of Producing Apples in Wenatchee Valley, Washington," Department Bulletin No. 500, "The Cost of Producing Apples in Western Colorado," and Department Bulletin No. 518, "The Cost of Producing Apples in Hood River Valley," have already been published.

Note.—Acknowledgment is due to the Office of Horticultural and Pomological Investigations of the Bureau of Plant Industry for material assistance in the preparation of this bulletin; also to Mr. J. Clifford Folger, who aided in securing the necessary data, and Mr. F. E. De Sellem, Horticultural Inspector at Large, North Yakima, for helpful suggestions.

including data on labor necessary for the annual upkeep of the orchard, on the care and harvesting of the crop, total investment, insurance, taxes, and all other expenses connected either directly or indirectly with production. One hundred and twenty records were taken.

Conditions prevailing in the Yakima Valley differ in some respects from those in any other of the important apple-producing regions of the Northwest. Two more or less distinct types of fruit farming are found. In the vicinity of the city of North Yakima is a highly specialized orcharding similar to that about Wenatchee, while in the lower valley, about the town of Zillah, there is a more diversified type of farming, with the growing of apples as one of several farm enterprises.

In this bulletin the acre is used as a basis of comparison. If the box were used as a unit, the figure for different districts might be misleading, since there might be a considerable variation in yield on orchards of the same size and age in different districts.

FACTS BROUGHT OUT.

Following is a brief summary of the more important facts brought out in this study of 120 bearing orchards in the Yakima Valley:

Average size of ranch:[1]

All records, 15.82 acres	North Yakima district (64 ranches), 10.79 acres.
	Zillah district (56 ranches), 21.57 acres.

Average size of bearing orchard:

All records, 6.39 acres	North Yakima district, 5.18.
	Zillah district, 7.77.

Average investment:

All records, per ranch, $14,504.32, of which $6,071.38 represents the bearing apple orchard.

All records, per acre of bearing apples, $1,079.87	North Yakima district, $1,531.25.
	Zillah district, $563.57.

Average annual yield:

All records	Per acre, 432 boxes.
	Per tree, 5.87 boxes.

Average net cost per box:

All records, $0.8002	Net labor cost, $0.3449.
	Costs other than labor, $0.4553.

Average interest on investment:

All records, $0.1999 per box (75.9 per cent of fixed cost and 24.98 per cent of total net cost of production).

THE YAKIMA DISTRICT.

Yakima County is located in the south-central part of the State of Washington (see fig. 1). It is bounded on the west by the main range of the Cascade Mountains, which separates it from the counties of Pierce, Lewis, and Skamania; on the south by Klickitat County; on the east by Benton County and the Columbia River; and on the north by Kittitas County.

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[1] The word "ranch" is a local term for any farm, and the word "rancher" is used in the sense of farmer.

The county contains a total of 2,622,760 acres, of which 742,082 are deeded. Of the latter acreage 187,084 are irrigable. In 1914 there were 47,829 acres in fruit, of which 41,955 acres, or 88 per cent, were in apples.[1] (See Table I.) Approximately the following acreages are in other fruits: Peach and apricot, 2,054; pear, 1,623; prune and plum, 279; cherry, 78; and mixed fruits, 1,840.

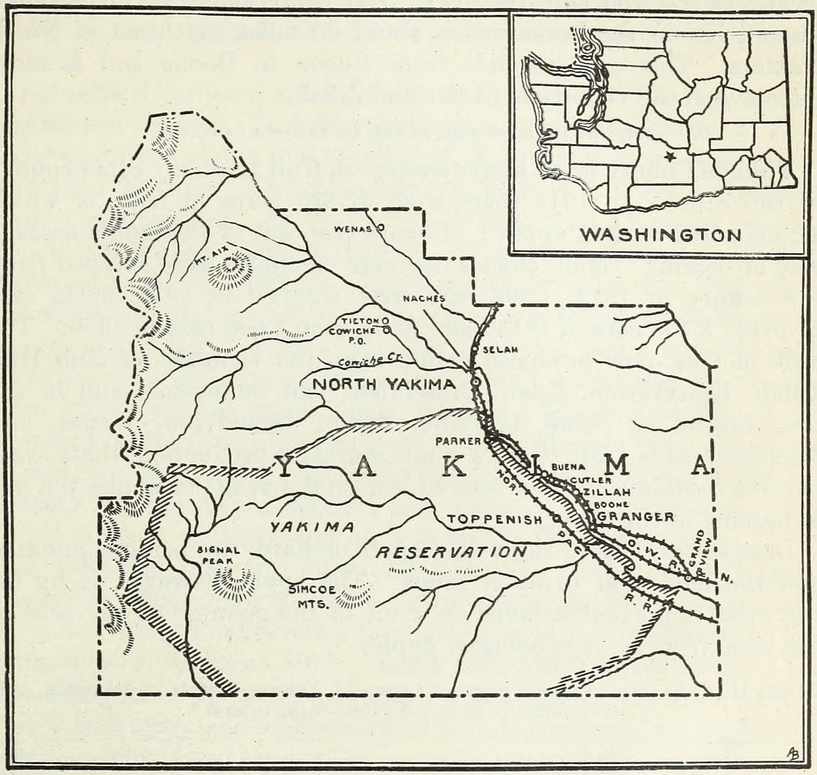

FIG. 1.—Outline map of Washington State and Yakima County, showing locations in the valley where the investigation was made.

TABLE I.—*Apple acreage at different ages in Yakima County.*

Age of trees.	Acreage.
1 year	2,517
2 years	5,018
3 years	8,000
4 years	6,460
5 years	6,152
6 years	5,280
Bearing	8,528
Total	41,955

Fruit is grown throughout the entire valley. Extensive plantings of young orchards are found in the Tieton, Cowiche, Selah, and Naches areas, which lie north and west of North Yakima. (See Table II.) Older commercial plantings are found in the vicinity of North

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[1] From the county assessor's report of the classification of lands in Yakima County, June, 1914. Since the report, about 2,000 acres of apple trees have been removed.

Yakima, Parker, Sawyer, Zillah, and Granger. Less intensive and somewhat younger plantings are found in the lower valley beyond Granger and as far down as Grandview.

This investigation was made principally in the vicinity of North Yakima and Zillah, where the older orchards are located.

The apple-producing areas visited near North Yakima are known locally as the Nob Hill, Broadway, and Fruitvale areas. The Zillah district lies in the lower valley about 20 miles southeast of North Yakima. This area extends from Buena to Boone and is most intensive in the vicinity of Cutler and Zillah.

IMPORTANCE OF THE APPLE IN YAKIMA COUNTY.

Yakima County has a larger acreage in fruit than any other county in the State. In 1914 there were 47,829 acres in fruit, of which 41,955 acres were in apples. Twenty per cent of this apple acreage was in bearing. More than 4,000 cars of apples were shipped from the county in 1912; 1,995 cars were shipped in 1913; 6,243 cars in 1914; 3,150 cars in 1915; and more than 7,000 cars in 1916. The bulk of fruit now produced comes from the vicinities of Nob Hill, Zillah, Reservation, Selah, Grandview, and Sunnyside, and in the near future the Selah, Cowiche, Tieton, Grandview, Wenas, and Naches areas bid fair to show a much greater production, these areas in 1914 containing 49 per cent of the total acreage of apples not yet in bearing in the county.

In some sections in the valley apple orchards are being eliminated and the lands put in other crops. The apple, however, is by far the most important commercial fruit in the county, 88 per cent of the total fruit acreage being in apples.

TABLE II.—*The principal fruit-producing areas of Yakima County, Washington, with the number of acres of different fruits in each.*[1]

County and areas.	Total acreage for—							
	Fruits.	Apples.	Bearing apples.	Peaches and apricots.	Pears.	Plums and prunes.	Cherries.	Mixed orchards.
Yakima County	47,829	41,955	8,528	2,054	1,623	279	78	1,840
Nob Hill	4,820	3,977	1,476	254	209	....	7	373
Zillah	3,683	3,137	1,310	162	212	44	4	124
Selah	5,880	5,683	615	21	73	17	....	86
Parker	3,250	1,898	268	789	319	189	12	43
Grandview	4,412	3,934	555	84	239	9	5	141
Cowiche and Tieton	3,973	3,845	76	27	28	....	4	69
Sunnyside	1,578	1,402	496	67	77	1	....	31
Upper and Lower Naches	3,532	3,305	432	37	77	....	....	113
Reservation	3,486	3,304	817	150	11	....	....	21

[1] From the county assessor's report of the classification of lands in Yakima County, June, 1914.

HISTORY AND DEVELOPMENT OF THE INDUSTRY.

A few white settlers came to Yakima Valley in the early sixties. The unlimited range encouraged stock raising; until the late eighties commercial fruit plantings were unknown to the valley. In the seventies farmers began in a small way to practice irrigation, taking water from rivers and creeks to irrigate small tracts in the adjacent lowlands. Probably the first irrigating ditch of any size was the Konewoc, which was built about 1878. This ditch, some 9 miles long, tapped the Yakima River at a point about 10 miles below the present site of the city of North Yakima. The irrigated land was used for growing alfalfa and wheat hay, but only upon a very limited scale. A few hopyards were found in the Ahtanum Valley as early as 1880.

By 1888 there were a few family orchards in the district, mostly prunes and apples. Probably the first commercial planting of fruit trees was made about this time by H. J. Bicknell in what is known as Parker Bottom. This planting consisted of 3 acres, principally prunes and peaches. In the spring of 1889 Fred Thomson set out, also in the Parker Bottom district, the next commercial planting, including probably the first commercial apple orchard in the valley. His whole planting consisted of 10 acres, including 3 acres of prunes, 3 acres of peaches, 3 acres of Ben Davis apples, and 1 acre of pears. At this time a few express shipments of fruit were being sent to the coast cities from the small home orchards. The fine quality of the fruit and its freedom from insect injury and diseases were incentives to commercial planting, and following the early plantings in Parker Bottom other orchards were set near Zillah, a few miles below, and also in Naches, at Selah, and on Nob Hill in the upper valley.

In 1888 and 1889 two important irrigation companies were organized; one under John A. Stone to undertake the Selah project and the other under Paul Schulze to develop what is now known as the Sunnyside Government ditch. Land with water rights at this time was selling from $30 to $50 per acre. Paul Schulze was the Northern Pacific land agent and had purchased from this railroad a considerable acreage which it had received as a part of the alternate sections given under Government land grants. The other sections of land were open to homestead. Both the above companies went into the hands of receivers in 1893 and emerged as private corporations again about three years later. The Government purchased the Sunnyside Canal in 1906 and about 1911 the Selah project was taken over by the growers in the form of a water users' association. About 1896 the Government built a canal to the Indian reservation and in 1909 began the Tieton and other reservation canals. Following the Selah and Sunnyside projects came the Congdon or Yakima Valley Canal and also the Selah-Moxee Canal.

Up to about 1897 the prune-growing industry occupied a position of chief importance; about this time the prices for prunes became so low that many orchards were pulled out.

In 1894 the total apple output shipped from the valley probably amounted to about 25 carloads and was assembled from small home orchards. The fruit was layer packed but not wrapped. The old 60-pound box, 12 by 12 by 21 inches was in common use at that time. The apples were marketed chiefly in coast cities and netted the growers about $1.50 per box. In 1896 Mr. Fred Thompson shipped from the Yakima Valley what was probably its first car of fruit to be sold east of the Mississippi River. This car consisted chiefly of peaches and pears.

It was about 1894 that the apple-planting period really began. Reliable estimates place the total acreage of all orchard land at about 3,000 acres in 1900 and the total apple crop for that year at about 200 carloads. This output was nearly doubled in the next two years, during which time the early commercial plantings were coming into bearing. With this development of the fruit industry had come the growing of alfalfa, potatoes, and hops upon a fairly large scale.

Growers received in the neighborhood of $1.50 per box for apples during these times, and this high price brought on a very extensive planting of apples, which reached a climax about 1907 and 1908. The first varieties to be planted were princiaplly Ben Davis, Winesap, Jonathan, Baldwin, and White Pearmain.

SOIL.

Yakima sandy loam occupies not only the principal portion of the Ahtanum Valley, where the investigations about North Yakima were made, but also the district in which Buena, Zillah, and Boone are located. This soil is typically a fine gray sandy loam, light and friable, and varies in depth from a few inches to 60 feet or more. It lends itself easily to cultivation and is well adapted to the crops which may be grown in this climate.

DISEASES AND PESTS.

Fire blight, both on the pear and apple, is a serious menace to the fruit industry of the valley. Many of the orchards suffered from the prevalence of this disease in 1912 and 1914. Considerable damage has been done each year and but for the efficient work of the county inspector and the organizations of the growers themselves a greater loss would have resulted.

Apple powdery-mildew has been found in all parts of the valley, affecting the Jonathan more than any other variety; but on the whole it has done little damage. Both iron sulphide and atomic sulphur have been used for its control. It is only within the last two years that it has caused valley-wide infection.

Collar-rot, as it is locally known, has been found in some of the orchards of the valley and many apple trees have been affected seriously. Methods of control of this disease are being studied.

The codling moth is perhaps the worst pest of the valley, but with thorough spraying at the correct periods it is believed that it may be controlled. The other insect pests of economic importance now known to be in the valley are San Jose scale, oyster-shell scale, Lecanium scale, woolly aphis, green aphis, and rosy-apple aphis.

Apple and pear scab are now found to a limited extent, but thus far have caused but little damage.

CLIMATE.

The climate of Yakima Valley is decidedly arid, and without irrigation the growing of agricultural crops would be impossible. The temperature during the summer often reaches 100° F., but because of the relatively low humidity it is not oppressive. The winters are generally mild with but light snowfall.

There was an annual average of 187.4 growing days at Yakima in the five years 1910–1914, inclusive. The Ahtanum Valley itself is well protected from severe winds; but in the lower valley, where the country is more open, winds often cause crop damage.

The mean annual precipitation for the five years 1910–1914, inclusive, at an altitude of 1,070 feet, North Yakima was 6.64 inches; in the Moxee Valley at an altitude of 1,000 feet it was 7.47 inches. For the 22 years 1893–1914, inclusive, the mean annual precipitation of the Moxee Valley was 8.36 inches. The greatest precipitation takes place in the months of November, December, and January, and the least occurs in the months of April, July, and August.

For the most part the climate of Yakima Valley may be said to be very pleasing and healthful.

TOPOGRAPHY.

Yakima County receives its water for irrigation purposes from the Yakima River and its tributaries. This river has its source on the eastern slope of the Cascade Mountains, taking an easterly and southeasterly course, entering the northern part of Yakima County and flowing into the Selah Valley, a plain about 4 miles in length. At the end of this valley it passes through a narrow gap into the upper Yakima Valley. From here it pursues its southerly course east of the city of North Yakima and about 6 miles south passes through what is known as Union Gap and enters its lower valley, in which are located Parker, Zillah, and Sunnyside. The upper valley is bounded on the north by Selah Ridge and Cowiche Ridge, and on the south by Yakima Ridge and Ahtanum Creek. The valley between the Yakima and Selah Ridges east of Yakima River is known as the Moxee Valley and that between Yakima and Cowiche Ridges west of Yakima River is known as the Ahtanum Valley. The total length of this valley is from 75 to 80 miles and the width is not greater than from 5 to 6 miles. The slopes of the ridges of the valley are steep and rocky, but the valley itself is nearly level, with a gentle slope toward the Yakima River. (Pls. I, II, III, and IV.)

METHOD OF PRESENTATION.

In analyzing the cost of production in the Yakima Valley it is deemed advisable to give the results of the management under the two more common methods of handling the soil, namely, clean cultivation and the mulch-crop system. The former refers to orchards which are annually cultivated and in which no cover or mulch crop is sown. The latter refers to orchards in which the growing of alfalfa, clover, and vetch is the practice. Alfalfa is grown in practically all the mulch-crop orchards considered in this study. The method of management is fully discussed under the subject Mulch Crop.

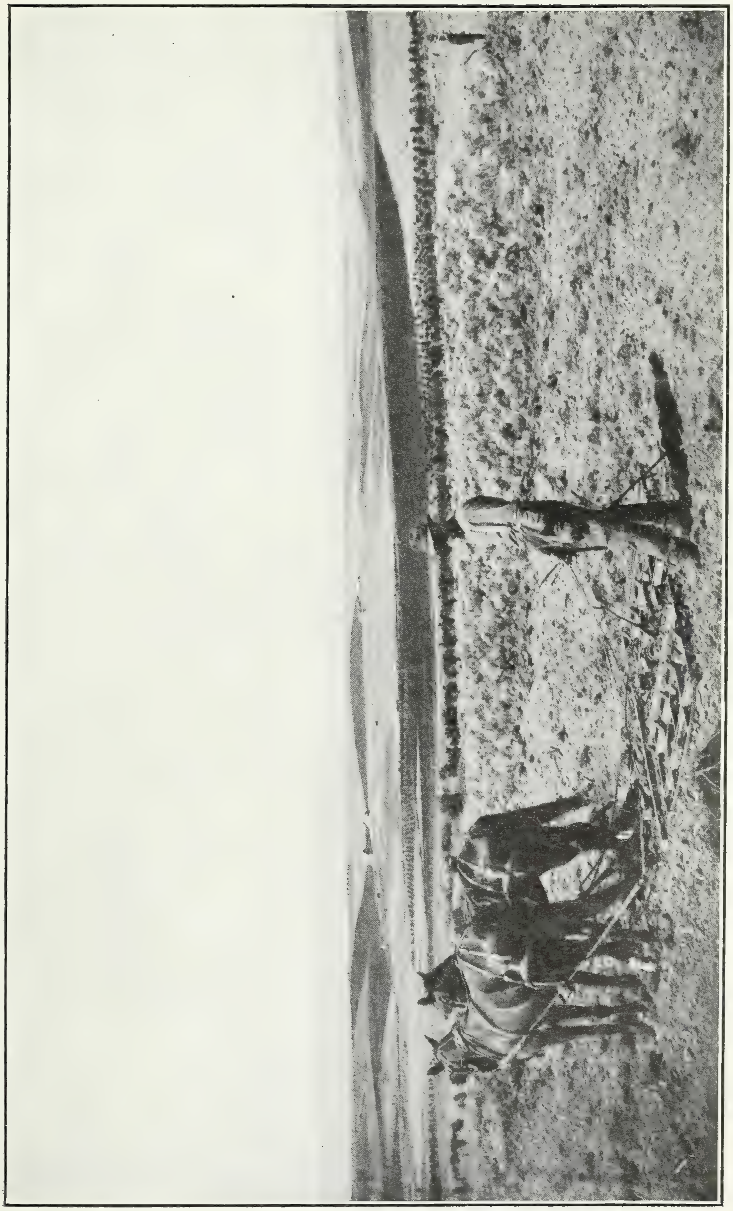
The cost of production of apples in orchards under each method of management will be given separately for North Yakima and Zillah. These will then be combined to show a cost of production of each method of management for the valley, and finally the cost of production will be given in all orchards considered in this study regardless of the method of orchard management.

Four kinds of costs are considered in arriving at the total annual cost of production—(1) maintenance, (2) handling, (3) material, and (4) fixed, which are subdivided as follows:

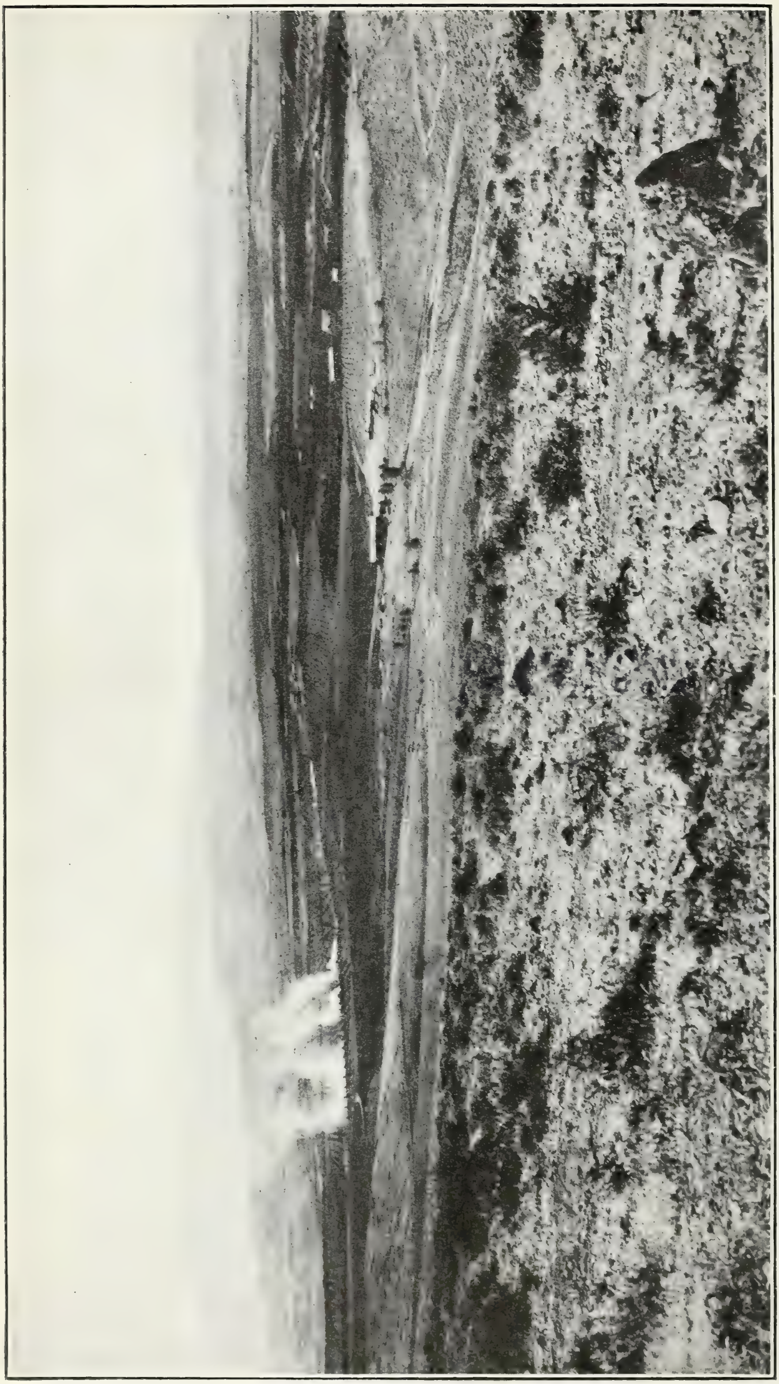
Labor costs.		Costs other than labor.	
Maintenance.	Handling.	Material.	Fixed.
Manuring. Pruning. Disposal of brush. Cultivating. Irrigating. Thinning. Propping. Spraying. Miscellaneous. Sowing mulch crop. Harvesting mulch crop.	Hauling shooks. Hauling boxes to and from orchard. Picking. Packing-house labor. Hauling packed boxes. Picking up and hauling culls.	Manure. Spray material. Seed. Gasoline and oil. Made-up boxes.	Interest. Apple-building charge. Equipment charge. Sprayer hire. Taxes. Insurance. Water rent.

FARM ORGANIZATION.

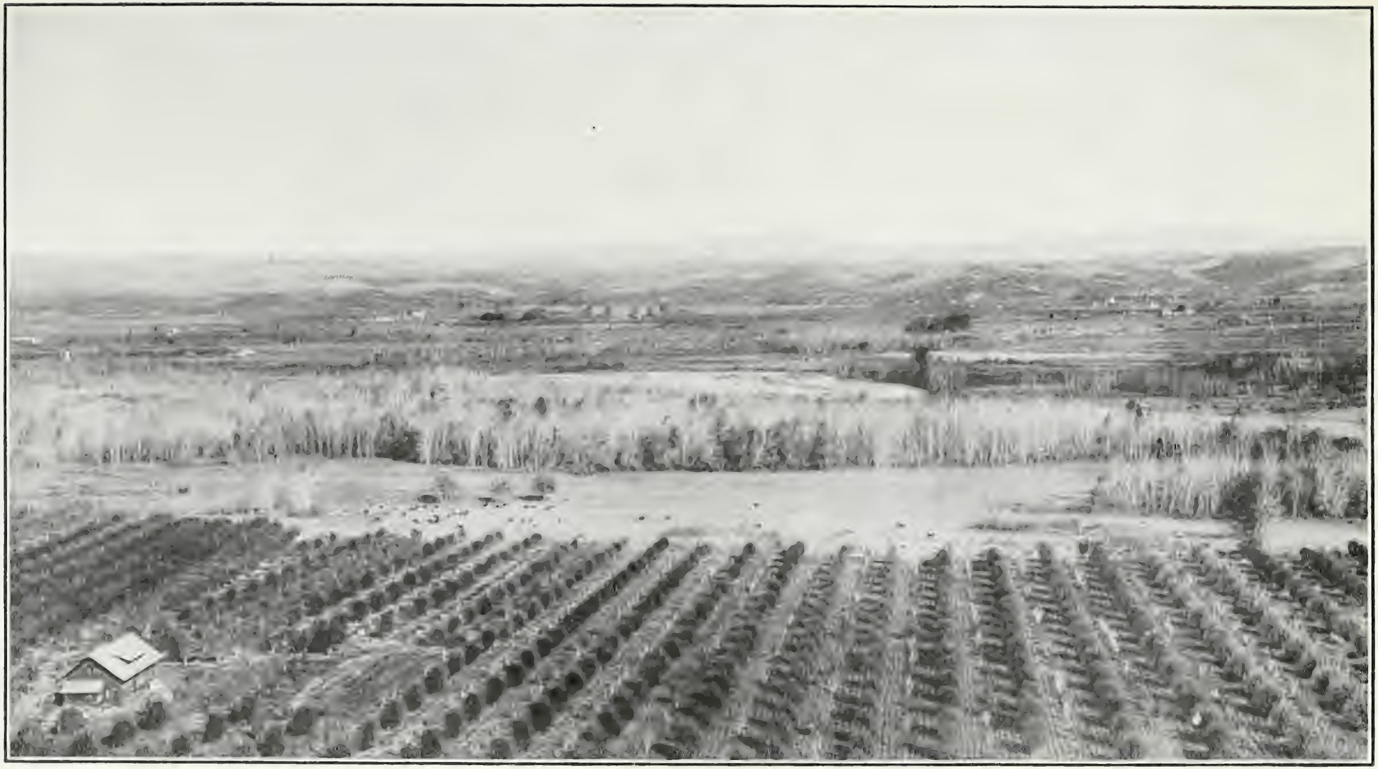
The most intensive type of specialized agriculture of the entire valley is found in the vicinity of North Yakima. The apple is the most extensively grown fruit, although the pear, peach, plum, and some of the smaller fruits are common. The ranches are small, with usually a tract of commercial orchard. However, most ranchers produce enough garden truck for their own families. Many of the owners do much of their own work. Not all ranches are fully equipped with the necessary implements for orchard work, though the owners are generally able to exchange, borrow, or hire them at their



CLEARING LAND PREPARATORY TO SETTING TREES IN THE YAKIMA DISTRICT.

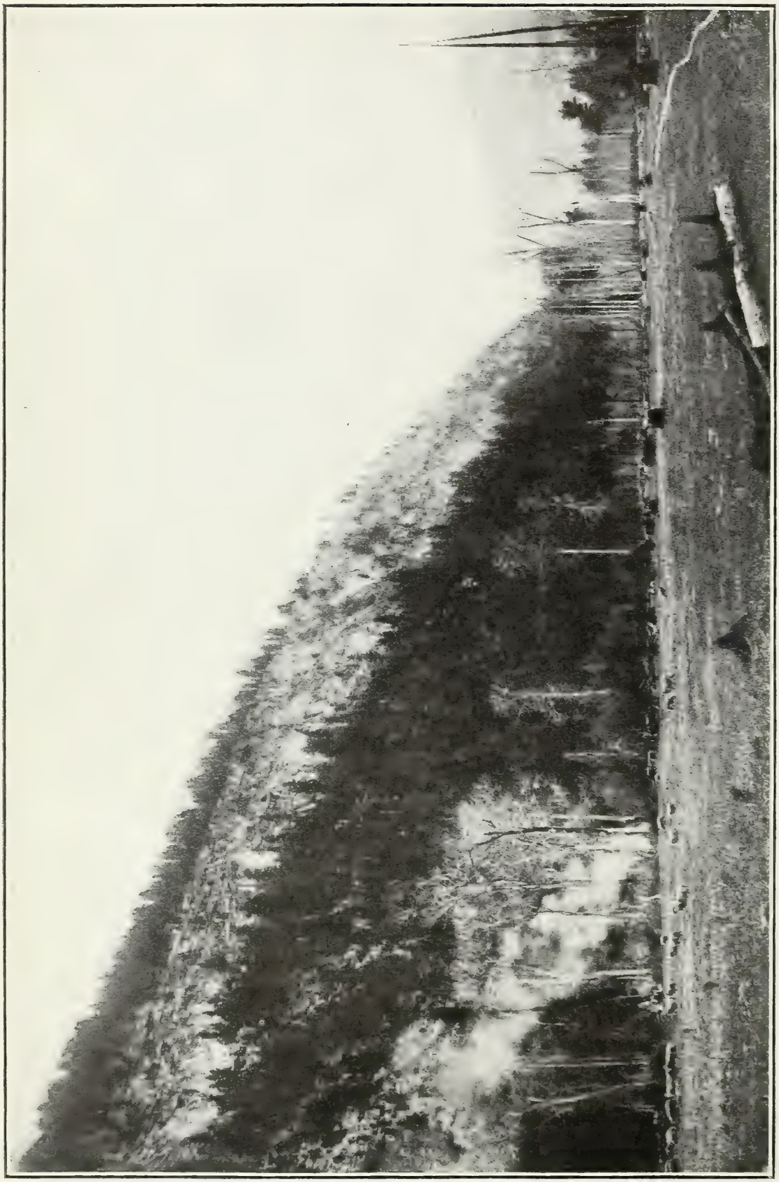


A View of the Outlying Fruit Section of Yakima Valley. This is an Extension of the "Nob Hill" Section.



VIEW OF THE LOWER NACHES VALLEY, ONE OF THE IMPORTANT FRUIT-GROWING VALLEYS TRIBUTARY TO THE YAKIMA DISTRICT.

The orchard in the foreground is one of apples and peaches interset.



STUMP LAND IN THE PROCESS OF BEING CLEARED.

Stump lands are found in the higher regions and upper valleys. They are much more expensive to clear than sagebrush lands.

convenience. Some keep but one horse, with which most of the light work may be done. For heavy work arrangements sometimes are made for the use of a neighbor's horse for short periods. The rancher usually keeps a cow, a few pigs, and a small flock of poultry. Where the orchards are under mulch-crop management there is a tendency to keep a somewhat greater number of such animals. Ranches in the Zillah district are comparatively large and more of an attempt is made at diversification than in the upper valley, where the orchards occupy a larger percentage of the farm acreage. Even so the type of farming remains highly specialized and fruit is the principal crop. Here is found a greater acreage of pears, cherries, and other fruits, and until recent years peaches were grown to a considerable extent. The Zillah ranches have a larger acreage in young fruit than those in the North Yakima district and more land is devoted to the growing of other crops, particularly alfalfa. The typical ranch is of such size that the operator devotes most of his time to the work on his own place. In this region there is a growing tendency to raise alfalfa in the orchards to be used for hog pasture.

SIZE OF RANCH.

The ranches of the North Yakima district are usually small. Of the 64 considered in this investigation, extreme acreages are 2 and 40. Most of the ranches range between 2 and 20 acres in size. The average ranch contains 10.79 acres, with 5.18 acres of apples in bearing. Nearly every ranch has a few pear, cherry, and plum trees and a small acreage of young apple trees. Nonbearing apples average 3.34 acres per ranch. On the average less than one-half acre is devoted to the growing of other crops. (See Table III.)

The apple orchard is usually of such size that one man can comfortably do all pruning and look after the necessary operations with but little extra help except during the thinning, spraying, and harvesting periods.

TABLE III.—*Average size of ranch and of areas in crops for 64 ranches in the North Yakima district.*

Item.	Method of culture.	
	Clean (43 records).	Mulch-crop (21 records).
Average acres in ranch	11.96	8.40
Average tillable acres in ranch	11.77	8.28
Average acreage in bearing apple orchard	5.49	4.52
Average acreage in young apples and other fruit	5.90	3.46
Average acreage in other crops	.38	.30
Tillable acres per horse	5.75	4.81

The 56 ranches in the Zillah district considered in this investigation are somewhat larger than those in North Yakima, ranging from 8 to 60 acres. The average size is 21.57 acres, with 7.77 acres in bearing apples. There is an average per ranch of 6.28 acres in nonbearing apple orchard and 1.79 acres in other fruits. As already indicated, a greater acreage is devoted to other crops here than elsewhere in the district, there being an average of 4.17 acres of such crops per farm, 3.23 acres of which are in alfalfa. On account of the size of farm perhaps the rancher is not able to put in as much time on the bearing apple orchard as is the usual case in the North Yakima district. (See Table IV.)

TABLE IV.—*Average size of ranch and of areas in crops for 56 ranches in the Zillah district.*

Item.	Method of culture.	
	Clean (32 records).	Mulch-crop (24 records).
Average acres in ranch	22.26	20.66
Average tillable acres in ranch	21.56	19.98
Average acreage in bearing apple orchard	7.70	7.85
Average acreage in young apples and other fruit	9.33	6.40
Average acreage in other crops, including pasture	4.53	5.73
Tillable acres per horse	8.04	7.92

TYPES OF RANCHERS.

Two distinct types of ranchers are found in the valley. In the North Yakima district are found men engaged in ranching who were formerly professional men and tradesmen in different parts of the United States. Many of these men are at present interested in some other business besides ranching. The orchard is more or less incidental to the welfare of such men. However, there are several men who came to this section unacquainted with the business of apple growing, expecting soon to acquaint themselves with it and make a comfortable living and at the same time have all the privileges of the near-by city. Many of the owners of these small tracts are interested in the development of orchards farther away from town.

In the Zillah district are found ranchers of a somewhat different type. Many of these men were engaged in other lines of farming before coming to this region to settle. Some came at an early date, when the price of land was between $30 and $50 an acre, but there are many who came during the boom period and paid high prices for their land. A number of the ranchers were eastern and central-western farmers. This type of rancher as a rule is acquainted with general farming and usually is found growing other crops than fruit and raising some stock besides.

The ranchers of both districts are generally well educated. Up-to-date schoolhouses are found in many parts of the valley. (See fig. 2.) A few men in the Zillah district own property farther down the lower valley and devote it somewhat to hay growing and cattle raising, but this is not the general rule.

INVESTMENT.

The average investment per ranch of the 120 ranches studied in the Yakima Valley was $14,504.32, or $1,235.70 per acre. The areas in proximity to North Yakima have the advantages of the city. In the Nob Hill section, nearness to North Yakima, beautiful location, and the numerous incidental advantages of such an ideal situation make this acreage almost a prohibitive investment to one who must depend solely upon the income from the apple business, for at the time of this investigation merely the interest on such an investment amounted to a large proportion of the total annual cost of apple production. However, many men with independent incomes, wishing to establish beautiful homes under ideal conditions, bought small tracts of orchard and retired from active business life, expecting that the apple business would give them fair incomes. Many did not then consider the interest on their investment. Furthermore, prices then received for apples were high and in many instances seemed to warrant the prices asked for land.

FIG. 2.—A community district school in the Tieton district, many miles from railroad. Such schools are a product of progressive ranches and progressive ideas. They are a measure of rural social conditions of the region.

As far as location and climate are concerned, it would be difficult to find in the Northwest apple-producing areas a region surpassing Yakima Valley.

Considering separately the 64 ranches in the North Yakima district, the average investment per ranch of 10.79 acres is $15,639.29, of which $7,525.78 is the estimated value of the bearing apple orchard per ranch. This estimated value of the average apple orchard is

52.57 per cent of the total investment. A greater valuation per acre was reported for ranches on which orchards are under mulch-crop than for those under clean-culture management. This is due primarily to location, land values being as a rule higher in the Nob Hill section, where more of the orchards are in a mulch crop, than in the Fruitvale or Broadway localities, where clean cultivation is practiced by nearly all orchardists from whom data were obtained. (See Table V.)

TABLE V.—*Average size of ranch and bearing orchard and average investment per ranch and per acre for 64 ranches in North Yakima district.*

Item.	Method of culture.		
	Clean.	Mulch-crop.	Combined.
Number of records	43	21	64
Average acreage per ranch:			
Total	11.96	8.40	10.79
In bearing apple orchard	5.49	4.52	5.18
Average investment per ranch:			
Total	$16,329.71	$14.225.57	$15,639.29
Land and improvement	$15,695.12	$13,532.00	$14,985.34
In bearing apple orchard	$7,708.14	$7.152.38	$7,525.78
Equipment	$335.88	$357.48	$342.97
Average investment per acre apple orchard:			
Total	$1,469.77	$1,657.14	$1,531.25
Equipment	$33.11	$39.12	$35.08
Per cent value apple orchard is of total investment per ranch [1]	51.00	55.79	52.57

[1] Average of percentage figures for the individual ranches.

The Zillah district presents a somewhat different aspect. It is located in the lower valley, which is not quite as highly specialized an apple-producing area as the North Yakima district. The ranches are larger, and, although more diversified, the raising of the apple is the chief ranch enterprise. The homes of the ranchers here are not so pretentious as those of the Nob Hill section, but the people enjoy all the advantages of an up-to-date rural community and have good train service to the city of North Yakima.

For the 56 ranches studied in the Zillah district the average investment per ranch of 21.57 acres is $13,207.21, of which $4,409.20 is the estimated value of 7.77 acres of bearing apple orchard per ranch. The value of the bearing apple orchard is 37.23 per cent of the total investment. (See Table VI.)

These investments are high in comparison with many of the farms in the Eastern apple-producing regions, but they are not exorbitant as compared with those of other Western and Northwestern apple-producing regions. (See Table VII.)

TABLE VI.—*Average size of ranch and bearing orchard and average investment per ranch and per acre for 56 ranches in Zillah district.*

Item.	Method of culture.		
	Clean.	Mulch-crop	Combined.
Number of records	32	24	56
Average acreage per ranch:			
Total	22.26	20.66	21.57
In bearing apple orchard	7.70	7.85	7.77
Average investment per ranch:			
Total	$13,487.83	$12,833.06	$13,207.21
Land and improvement	12,334.06	11,787.29	12,099.73
In bearing apple orchard	4,338.75	4,503.13	4,409.20
Equipment	486.25	464.46	476.91
Average investment per acre apple orchard:			
Total	564.38	562.50	563.57
Equipment	25.62	26.62	26.09
Per cent value apple orchard is of total investment per ranch [1]	35.42	39.64	37.23

[1] Average of percentage figures for the individual ranches.

The interest on the apple-orchard investment in these districts is very high, averaging 24.98 per cent of the total annual net cost of production on the 120 farms studied.

The investment in equipment is heavy, totaling $342.97 per ranch, or $35.08 per acre, in the North Yakima district; $476.91 per ranch, or $26.09 per acre, in the Zillah district; and $405.48 per ranch, or $30.88 per acre, for the 120 ranches studied.

The equipment investment usually includes all necessary equipment for orchard work, such as spray outfit, spring and spike tooth harrows, plows, cultivators, wagons, pruning tools, ladders, and miscellaneous orchard tools.

The average investment per ranch for the 120 considered in this study was $14,504.32, of which $6,071.38 was in bearing apple orchards. (Ranches averaged 15.82 acres and orchards 6.39 acres.) This apple-orchard investment is 45.41 per cent of the total investment.

TABLE VII.—*Comparative investments of four commercial apple-producing regions.*

Item.	Yakima Valley.	Hood River Valley.	Wenatchee Valley.	Western Colorado.
Average investment per ranch	$14,504.32	$23,487.36	$20,974.00	$16,366.87
Average land and improvement investment per ranch	$13,638.73	$22,503.70	$20,097.00	$15,340.14
Investment in bearing apple orchard per ranch	$6,071.38	$12,257.87	$12,250.00	$6,657.34
Investment in bearing apple orchard per acre	$1,079.67	$990.74	$1,925.00	$653.49
Equipment investment per ranch	$405.48	$491.87	$444.00	$708.51
Equipment investment of bearing apple orchard per acre	$30.88	$22.67	$44.65	$29.56
Per cent value of total ranch investment the bearing orchard represents	45.41	54.03	58.00	40.70
Average acres per ranch	15.82	39.49	11.40	38.24
Average acres in bearing apples per ranch	6.39	12.45	6.50	10.81

ORCHARDS.

SIZE.

The largest orchard considered in the North Yakima district was 20 acres, the smallest 1 acre. The orchards from which records were obtained under mulch-crop management averaged 4.52 acres, a little smaller than the clean-cultivated, which average 5.49 acres. The bearing apple orchard occupies about the same proportion of the ranch under either system of management. There is an average of 5.18 acres of bearing apple orchard out of 10.79 acres per ranch on the farms studied in the North Yakima district.

In the Zillah district the orchards under mulch-crop management average 7.85 acres, and clean-cultivated orchards average 7.70 acres. The bearing apple orchard occupies about the same proportion of the ranch under either method of management. Considering all bearing orchards in the Zillah district, regardless of the method of soil management, the average size is 7.77 acres out of an average of 21.57 acres per ranch.

The average bearing apple orchard of the valley, when all records are considered, is 6.39 acres out of the average of 15.82 acres per ranch.

AGE.

The average age of all orchards considered in this investigation was 12.6 years. The clean-culture orchards average 12.73 years and the mulch-crop orchards average 12.37. The average age of orchards in the Zillah district was 12.54 years, while in the Yakima district the average was 12.66. Trees in these districts, as in other Northwestern apple-producing sections, may be considered as bearing at 7 years of age, and only orchards this old or older were considered in this investigation. Practically all varieties will bear on an average a box or more of marketable apples per year between the ages of 6 and 9. There were not yet in bearing 1,827 acres, or 58.24 per cent of the total apple acreage in the Zillah district; in the Nob Hill area there were 2,501 acres, or 62.89 per cent. The age of bearing orchards in the Zillah district varies from 8 to 22 years, though generally there seem to be two groups, those 8 to 12 years and those 18 to 22 years. The younger orchards appear to be the best cared for and the most profitable.

VARIETIES.

Between 50 and 60 varieties are grown by the orchardists from whom records were taken. The older orchards of the valley contain such varieties as Monmouth, York Imperial, Twenty Ounce, Missouri, and Ben Davis. As in other Northwest regions, earlier plantings were made of varieties well known to the ranchers in their home States. The small family orchards were the beginning of the industry and contained many of the above mentioned varieties. With the development of the industry came the knowledge of the varieties better adapted to the region.

The principal commercial varieties now grown in Yakima County are Winesap, Jonathan, Ben Davis, Esopus, Missouri, etc. (See Table VIII.)

TABLE VIII.—*Ten varieties of apples having the largest acreage in Yakima County.*

Variety.	Acres.	Per cent of total acreage.
Winesap	6,201	15.52
Jonathan	5,916	14.81
Ben Davis	5,103	12.77
Esopus (Spitzenberg)	2,654	6.64
Missouri	2,578	6.45
Yellow Newtown	2,366	5.92
Rome Beauty	2,203	5.51
Gano	1,339	3.40
Arkansas (Black Twig)	1,075	2.69
Stayman Winesap	991	2.48

METHOD OF ORCHARD PLANTING.

Many of the older orchards of the valley are set as close as 15 by 15 or 20 by 20 on the square. However, in many instances the orchardists are removing part of the trees so as to get sufficient space for the growth and development of those remaining. Among the younger orchards the distances set vary from 20 by 20 to 30 by 30, trees being set on different plans. As might be expected, there is little difference in the plan of setting between the clean-cultivated and the mulch-crop orchards, since most of these orchards were set before any consideration was taken of an orchard mulch crop. Considering all orchards in the Zillah district, regardless of the plan of setting, there was an average of 68.2 trees per acre. In the North Yakima district there was an average of 78.2 trees per acre. Considering all records taken in the valley, there was an average of 73.6 trees per acre.

YIELDS.

Records of yields were obtained from each orchardist covering as long a period as possible. (See Table IX.) The plan was to get records covering at least a 5-year period, so that any abnormality in one year or another might be minimized in the average. The belief was that fair results could not be counted on from the consideration of any one year's yield, since many conditions, such as the weather, insect pests, and fungus diseases, often make the yield for a given season entirely unreliable as a measure of the business of a district. In 1911 a severe frost affected the yield of many of the orchards of the valley. Two ranchers considered in this investigation lost their entire crops that year.

TABLE IX.—*Average yield per acre, 1910–1914, inclusive, for 120 orchards in Yakima Valley.*

Year.	North Yakima district.		Zillah district.		North Yakima and Zillah districts combined.	
	Number of records.	Average yield in packed boxes.	Number of records.	Average yield in packed boxes.	Number of records.	Average yield in packed boxes.
1910	20	617.1	24	464.7	44	534.0
1911	30	277.9	33	216.8	63	246.0
1912	51	617.3	48	591.3	99	604.7
1913	62	354.6	54	328.6	116	342.5
1914	64	590.5	56	452.3	120	526.0

There is a difference in the number of estimates considered in different years, yet the figures presented reflect the tendency to alternate bearing, as well as the effects of weather conditions.

The age of the trees has a marked bearing on the yield for these districts. Some varieties of apples in the Yakima Valley bear a few apples at the age of 5 years. However, in arriving at the average yield for the valley only the yields from orchards aged 7 years and over are considered. The majority of orchards from which records were taken were between the ages of 9 and 15 years at the time of this study. Each orchard is given the same weight and the acre is used as a basis of comparison. All yields were taken from orchards representitive of the district, so as to make the data comparable. There is a gradual increase in the yields of trees from the time they are 6 years of age. (See Table X.)

It will be noted that the yield per tree increases rapidly with the age until the tree reaches 9 years of age and that thenceforward the increase is more gradual.

There were not enough records of orchards over 12 years of age to furnish reliable figures.

TABLE X.—*Yield per acre from trees of different ages in the Yakima Valley.*

Number of estimates.	Age of trees.	Yield in packed boxes.	Trees per acre.	Boxes per tree.
42	6	175	75.66	2.32
58	7	311	73.50	4.23
73	8	350	73.82	4.74
70	9	453	73.71	6.14
56	10	454	74.32	6.10
51	11	469	72.12	6.51
33	12	505	73.97	6.83
Average from total			73.81	

The size of the orchard appears to have considerable influence on the yield throughout the districts. (See Table XI.) Small orchards have more trees per acre than the larger ones, and as a rule the ranch is proportionately small. The trees in the small orchard usually get more care and individual attention than those in the big orchard.

The average yield of the orchards studied is here presented regardless of the size of orchard, variety of apple, and the age of the trees, 7 years and over, without consideration of the year.

The average yield per acre in the North Yakima district in orchards under clean-culture management was 475 packed boxes, or 6 packed boxes per tree. In the orchards considered 79 trees per acre was the average. The average yield per acre in orchards under the same method of management in the Zillah district, with an average of 69 trees per acre, was 421 packed boxes, or 6.1 boxes per tree.

The average yield per acre in the orchards of the North Yakima district under mulch-crop management was 434 packed boxes per acre, or 5.7 boxes per tree. These orchards averaged 76 trees per acre. The average yield per acre in the Zillah district for orchards under the same system of management was 367 packed boxes, or 5.5 boxes per tree. These orchards averaged 67 trees per acre.

TABLE XI.—*Yields of 120 orchards of varying acreages and different cultural methods in Yakima Valley.*

Acres in orchard.	Clean-cultural management.					Mulch-crop management.				
	Number of records.	Average age.	Packed boxes per acre.	Trees per acre.	Boxes per tree.	Number of records.	Average age.	Packed boxes per acre.	Trees per acre.	Boxes per tree.
1 to 5	44	12.8	496.8	77.3	6.43	22	12.5	435.2	73.8	5.90
6 to 10	19	12.9	414.3	74.2	5.58	19	12	375	66.6	5.63
11 to 20	12	12.3	348.3	67.1	5.19	4	13.8	304.2	80.4	3.78
Total	75	12.7	452.2	74.9	6.04	45	12.4	398.1	71.3	5.58

Acres in orchard.	Combined management.				
	Number of records.	Average age.	Packed boxes per acre.	Trees per acre.	Boxes per tree.
1 to 5	66	12.7	476.3	76.2	6.25
6 to 10	38	12.5	394.7	70.4	5.61
11 to 20	16	12.7	337.3	70.3	4.80
Total	120	12.6	431.9	73.6	5.86

The orchards under clean cultivation show a slightly larger yield than those under mulch-crop management. The difference is not large, however, when considered on a comparable basis. There is an average yield of 0.3 box more per tree under clean-cultural than under mulch-crop management in the Yakima district and 0.6 box more per tree in the Zillah district. Assuming that there are the same number of trees per acre—for example, 70—there would be an average yield of only 21 boxes more per acre under clean-cultural than under mulch-crop management in the Yakima district, while in the Zillah district there would be an average yield of 42.1 boxes more per acre under clean-cultural management.

A few years ago all men in the valley practiced clean cultivation. Of late years many of the orchards have been sown to alfalfa or clover. (See fig. 3.) In many cases the orchards which were clean cultivated showed the effect of too intensive cultivation and the need of humus. There seems to be a tendency on the part of some growers, after orchards have been sown to a mulch crop, to neglect the orchard in different ways. These seemingly small oversights have their effect on the physical condition of the trees, and thus upon the yield. This is especially noticeable in the Zillah district, where men are using their mulch-crop orchards for pasturing hogs. On the whole, these orchards are not managed so carefully and thoroughly as those under clean cultivation. Great care must be taken with the Yakima Valley orchards in a mulch crop until the practice has been in vogue for a sufficient time to enable the growers to become familiar with the details and results of mulch-crop management. Not alone in the Northwest does there seem to be this tendency to neglect orchards in mulch crop, but in some of the larger commercial apple-producing sections of the East a similar tendency is apparent, especially when the price of apples does not seem to warrant scrupulous care.

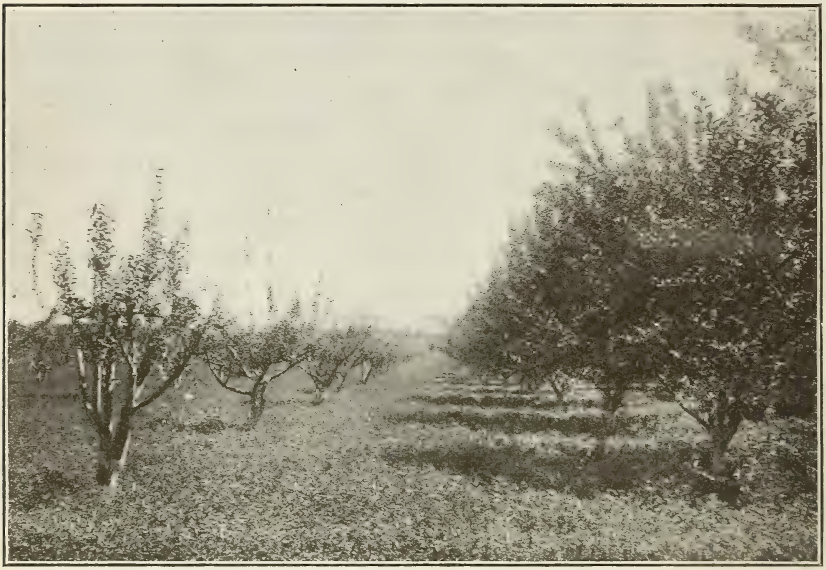


FIG. 3.—An 8-year old Esopus and Winesap orchard in the Zillah section. The Esopus trees are badly affected by blight. Note the dense mulch crop of alfalfa.

Since the mulch crop has not been used generally in this district for any length of time, the true effects, as far as yields are concerned, do not seem yet to be in evidence. It is a recognized fact, however, that the orchards are in need of humus, and perhaps in many cases the mulch-crop system, with proper management, would bring good results. However, whatever the system of management, if the orchards are to be kept in good physical condition and are to bear the average crop or more, due care must be taken in the management.

Considering the valley as a whole, regardless of whether the orchards are under clean-cultural or mulch-crop management, there is an average yield of 432 packed boxes per acre, or 5.87 boxes per tree, the orchards ranging from 7 to 22 years of age and averaging 73.6 trees per acre.

ORCHARD MAINTENANCE.

Under orchard maintenance are included those practices which at the time of this study usually were followed by 120 orchardists of the Yakima Valley in the upkeep of their bearing apple orchards. Among these are manuring, pruning, disposal of brush, soil management, thinning, propping, spraying, and any miscellaneous labor previous to handling the crop.

MANURING.

Manuring is the annual practice of 77 per cent of all orchardists considered in this investigation. It is obvious from the small number of work horses and other stock on the average ranch that the amount of manure annually produced is small, yet few of the ranchers buy any manure in town or have it shipped in from other points. Most of the manure produced is usually applied on the bearing apple orchard, except for the small amount which is often used on the garden. Often, however, growers are found who make a practice of applying a considerable amount on the younger orchards. As a rule, there is not enough produced on the average ranch to manure the entire bearing apple orchard each year. (See Table XII.)

Eighty per cent of the ranchers visited in North Yakima and 73 per cent in Zillah made a practice of manuring all or a portion of their orchards each year. The former apply an average of 4.78 tons and the latter 7.72 tons per acre.

TABLE XII.—*Average time, tons, and cost per acre when a crew of one man and two horses is used for manuring orchards in Yakima Valley.*

District.	Number of records.	Hours.		Acres in 10 hours.	Labor cost.	Tons.	Material cost.	Total cost.
		Man.	Horse.					
Under clean-cultural management:								
North Yakima	25	8.51	17.02	1.17	$4.68	5.52	$8.28	$12.96
Zillah	21	10.88	21.76	.92	5.99	8.50	12.75	18.74
North Yakima and Zillah	46	9.59	19.18	1.04	5.28	6.88	10.32	15.60
Under mulch-crop management:								
North Yakima	14	7.49	14.98	1.34	4.12	4.14	6.21	10.34
Zillah	14	9.05	18.10	1.10	4.98	5.62	8.43	13.41
North Yakima and Zillah	28	8.27	16.54	1.21	4.55	4.88	7.32	11.87

Considering the orchardists in the North Yakima district who actually apply manure, regardless of method or crew used, it requires 7.70 man hours and 13.93 horse hours to apply 4.78 tons per acre, at a cost of $11.20 for both material and labor, while in the Zillah district it requires 12.06 man hours and 20.73 horse hours to apply 7.72 tons per acre at a cost of $17.71 for both material and labor. Considering only those orchardists in both districts who actually manure, it requires 9.65 man hours and 16.96 horse hours to apply 6.09 tons per acre at a cost of $14.10 for material and labor. Seventy-six per cent of all orchardists under mulch-crop management and 77 per cent under clean-cultural management manure each year. However, considering the small amount of manure produced on the average ranch and the small acreage covered each year, much more was actually applied on the latter than on the former, the latter applying 6.74 tons and the former 4.99 tons per acre.

Different methods are used in applying manure, some men using a sled and others a wagon for hauling purposes. Manure is applied during the fall and winter months, usually being spread from the sled or wagon as the hauling is done. A few, however, put it in piles and spread it at their convenience. If there are certain trees which seem to need manure more than others, it is applied to these trees rather than spread uniformly throughout the orchard. Eighty per cent of the orchardists manuring each year use a one-man and two-horse crew, and 12 per cent use a one-man and one-horse crew. The remainder use a crew of two men and two horses.

TABLE XIII.—*Number of hours and cost per acre required for manuring in orchards in Yakima Valley.*

District.	Number of records.	Hours.		Labor cost.	Tons per acre.	Material cost.	Total cost.
		Man.	Horse.				
Under clean cultural-management:							
North Yakima	43	6.05	11.00	$3.16	4.02	$6.03	$9.19
Zillah	32	10.14	17.29	5.13	6.81	10.21	15.34
North Yakima and Zillah	75	7.80	13.68	4.00	5.21	7.82	11.82
Under mulch-crop management:							
North Yakima	21	6.32	11.31	3.28	3.38	5.07	8.35
Zillah	24	7.09	12.37	3.63	4.11	6.17	9.80
North Yakima and Zillah	45	6.73	11.88	3.46	3.77	5.66	9.12
All orchards:							
North Yakima	64	6.14	11.10	3.20	3.81	5.72	8.92
Zillah	56	8.83	15.18	4.48	5.65	8.48	12.96
North Yakima and Zillah	120	7.40	13.00	3.80	4.67	7.01	10.81

Table XIII shows that more manure is applied per acre in the Zillah than in the North Yakima district, also that 2 tons more are applied per acre on orchards under clean-cultural management than those under mulch-crop management. There is little difference in the time consumed in applying manure under the different conditions.

Regardless of the orchard management, a crew of one man and two horses will cover 1.10 acres in 10 hours, applying 6.12 tons per acre at a cost of $14.19 for labor and material.

Considering all records, regardless of method of applying or crew used, there is a charge of 7.40 man-hours and 13.00 horse-hours per acre or a labor cost of $3.80 and material cost for 4.67 tons of $7.01, making a total manure cost of $10.81 per acre.

PRUNING.

Pruning is an annual practice of all orchardists throughout the valley. It is usually done during the winter and early spring, when the trees are still dormant. The ranchers, members of their families, or the regular hired help do most of the pruning, but a few have this work done by contract labor.

The majority of growers prune heavily every year. Some do the heavy pruning in the years when a big crop is expected, lessening to a great extent the amount of labor and cost necessary for thinning and propping. However, the practice of heavy pruning preceding a large crop does not hold true in all instances. Pruning is really another method of thinning, although even with careful pruning it is usually necessary to do a certain amount of thinning. The amount of pruning also has a bearing on the health and vigor of the individual tree. Very few orchardists make a practice of summer pruning.

TABLE XIV.—*Cost of pruning in orchards in Yakima Valley.*

District.	Number of records.	Average number of acres in orchard.	Trees per acre.	Average age.	Trees pruned in 10 hours.	Man-hours per acre.	Cost.		
							Per acre.	Per tree.	Per box.
Under clean-cultural management:									
North Yakima	43	5.49	79.21	12.58	14.10	56.16	$14.04	$0.177	$0.0296
Zillah	32	7.70	69.07	12.94	13.72	50.36	12.59	.182	.0299
North Yakima and Zillah	75	6.44	74.88	12.73	13.95	53.69	13.42	.179	.0297
Under mulch-crop management:									
North Yakima	21	4.52	76.26	12.81	14.03	54.38	13.60	.178	.0313
Zillah	24	7.85	67.03	12.00	14.14	47.39	11.85	.177	.0323
North Yakima and Zillah	45	6.30	71.33	12.37	14.08	50.65	12.66	.178	.0318
All orchards:									
North Yakima	64	5.18	78.24	12.66	14.10	55.58	13.90	.179	.0301
Zillah	56	7.77	68.19	12.54	13.50	49.08	12.27	.179	.0308
North Yakima and Zillah	120	6.39	73.55	12.60	14.00	52.55	13.14	.179	.0304

On account of the closeness of setting and the rapid growth of the trees, it is necessary that this operation be done every year in order to keep the trees within reasonable control. There appears to have been no definite plan of shaping the trees which were planted earlier in the valley, but in the younger orchards the style of pruning is toward a vase shape with open head. In the better cared-for orchards three to five leaders usually were chosen and headed back for the first 3 to 5 years, after which the pruning may be said to have consisted of merely the thinning out of the heavier lateral growth along the main limbs each year. When these trees reach the age of 12 years they usually are severely headed back, and from then on are pruned in such a manner as to prevent them from reaching a size or shape which will inconvenience the operator in doing the principal orchard operations. In the older orchards comparatively little heavy wood is cut from the trees.

Many factors affect the time required for this operation, chief among them being the variety, size, age, and number of trees per acre, as well as the expertness of the pruner. Perhaps the greatest of these factors is the pruner himself. His skill and ideals are told by each tree throughout the orchard. In considering these data no detailed study was made of the influence of these factors, the object being merely to obtain the average time required for the operation.

There appears to be little difference in the cost of this operation in the two districts. (See Table XIV). The majority of farms and orchards do not vary greatly in size, so that the time required for the pruning is not affected greatly by the size factor. However, where the ranches are small a larger percentage of the acreage is in bearing apples and usually there is a greater number of trees per acre. In the Nob Hill section this is especially true, for the orchards occupy such a large percentage of the total acreages and there is usually so little other work to be done that the men spend more time on this operation than do the farmers of the Zillah district, because they do not feel the pressure of other work.

Apparently there is little difference in the cost of pruning the trees under clean-cultural management as compared with those under mulch-crop management. There is, however, considerable variation in the number of trees which some men give as the average number which they are able to prune per day, the extremes being 6 and 60. Considering the valley as a whole, it is found that a man will prune an average of 14 trees 12.6 years of age in a 10-hour day.

The acre cost for pruning in the North Yakima district is $13.90; in the Zillah district it is $12.27. Considering the valley as a whole, the pruning cost is 19.5 per cent of the gross labor cost up to harvesting time. The tree cost for this operation (18 cents) is the same in both districts. The difference in the acre cost is due to the fact that there are 78.2 trees per acre in Yakima and but 68.2 in Zillah. Taking the valley as a whole, with an average of 73.55 trees per acre having an average of 12.6 years, 52.55 man-hours are required to prune an acre, at a cost of $13.14, or 18 cents per tree.

DISPOSAL OF BRUSH.

Several rather widely varying methods of brush disposal are employed, hence there is considerable range in the cost of this operation. A normal time could not be expected where there is such a wide variation in controlling factors. The regularity of pruning, the amount and kind of wood removed, as well as the method of handling and disposing of the brush, each has a considerable bearing on the time required for this operation. The cost of disposing of brush is nearly proportionate to the cost of pruning.

TABLE XV.—*Annual cost of disposing of brush in orchards in Yakima Valley.*

District.	Number of records.	Acres in orchard.	Hours.		Cost.		
			Man.	Horse.	Per acre.	Per tree.	Per box.
Under clean-cultural management:							
North Yakima	43	5.49	10.54	12.50	$4.51	$0.057	$0.0095
Zillah	32	7.70	12.21	10.98	4.70	.068	.0112
North Yakima and Zillah	75	6.44	11.25	11.85	4.59	.061	.0102
Under mulch-crop management:							
North Yakima	21	4.52	10.46	11.26	4.30	.056	.0099
Zillah	24	7.85	12.98	9.88	4.73	.071	.0129
North Yakima and Zillah	45	6.30	11.81	10.53	4.53	.064	.0114
All orchards:							
North Yakima	64	5.18	10.51	12.09	4.44	.057	.0096
Zillah	56	7.77	12.54	10.51	4.71	.069	.0118
North Yakima and Zillah	120	6.39	11.46	11.35	4.57	.062	.0106

There is little difference in the cost in the orchards under clean-cultural as compared with those under mulch-crop management. Considering all the records taken the former cost per acre is $4.59 and the latter $4.53. (See Table XV.)

The two more common methods used in disposing of the brush are:

1. A crew of either one man and one horse or two men and team with a wagon or sled is used to pick up, haul, and burn the brush left by the pruner.

2. The brush is often placed in piles. A crew, varying in size as stated above, pick up the brush either by hand or with forks, haul, and burn it.

In some instances a horse rake is used to clean up and carry the brush to a burning-place. However, two-man and two-horse crews are most commonly used in brush disposal in both the upper and the lower valley.

It is a general practice in some orchards where large limbs are removed to have the same trimmed up and used for fire wood. Where such a practice is usual, the time required for trimming up, together with the hauling of the wood to the ranch house, is considered and a credit to the orchard is made for the same.

There is little difference between the cost of removing brush in the North Yakima and in the Zillah districts. Considering all records regardless of the crew used, there is an annual charge for removing brush of 11.46 man-hours and 11.35 horse-hours, or an acre cost of $4.57.

SOIL MANAGEMENT.

Not many years ago the orchardists of the irrigated regions were warned not to allow any vegetation to occupy the land between their trees, lest the trees be robbed of food and moisture. It was soon learned, however, that many of the soils of the arid and semiarid regions were well supplied with mineral matter, but lacked one element essential to the healthful and profitable development and maintenance of tree growth, namely, nitrogen. This lack, often made obvious by the condition of the trees themselves, forced many of the orchardists of the Northwest to resort to the use of such legumes as alfalfa, clover, and vetch to supply the missing element.

It now appears that the Northwest orchardists have done much in solving the problem of the high cost of soil management by the introduction of these crops. Though the use of legumes is a comparatively recent innovation, nevertheless the method of management of orchards under mulch crop now in vogue in the valley will be considered in this bulletin. The majority of orchards considered under this heading have used some legume as a mulch crop for the past 3 to 5 years.

CLEAN CULTIVATION.

The importance of cultivation in the cost of maintenance in orchards under clean-tillage methods is shown by the fact that when all orchardists using this system are considered the annual cultivation charge per acre is $11.26, or 15.92 per cent of the total gross labor cost up to harvesting time. The soil of the valley is such that many men do not find it necessary to use the plow for breaking the land, but depend principally upon the disk.

Table XVI shows the frequency with which different implements are used by orchardists in the Yakima district who practice clean cultivation. Table XIX gives the same for the Zillah district.

TABLE XVI.—*Implements and the number of orchards in which each is used in 43 orchards under clean-cultural management in the Yakima district.*

When used.	Plow.	Disk harrow	Spring-tooth harrow.	Spike-tooth harrow.	6-foot cultivator.	Cultivator.	Float.	Crease.
Before first irrigation	29	12	22	29	26	7	8	43
Following first irrigation	....	2	15	14	24	6	2	43
Following second irrigation	....	....	13	10	26	5	2	41
Following third irrigation	....	....	10	7	19	4	....	32
Following fourth irrigation	....	....	4	....	7	2	....	11
Following fifth irrigation	....	....	....	....	1	....	....	....

It is the prime object of each orchardist following this method of management so to till the soil that a deep mulch which will conserve the moisture is present throughout the growing season. (See fig. 4.)

The soil is such that many orchardists do not feel the necessity of plowing annually. It is the practice, however, to begin some cultivation as early as possible in the spring, so as to conserve the moisture from the rain and snow of the winter.

The soil, broken by the various implements previously mentioned, is usually well worked, so that a dust mulch is formed. All growers make a practice of working the orchard both ways, many times practicing what is known as "zigzagging" in order to cultivate close up to the trees.

The importance of these early cultivations is shown by the fact that more than 40 per cent of the total cultivation, exclusive of plowing, is made before the first irrigation. After the soil is once put in good condition comparatively little labor ordinarily will be required to keep it in condition to prevent the loss of moisture. Table XVII gives the average day's work with various cultural implements used by the orchardists of the valley.

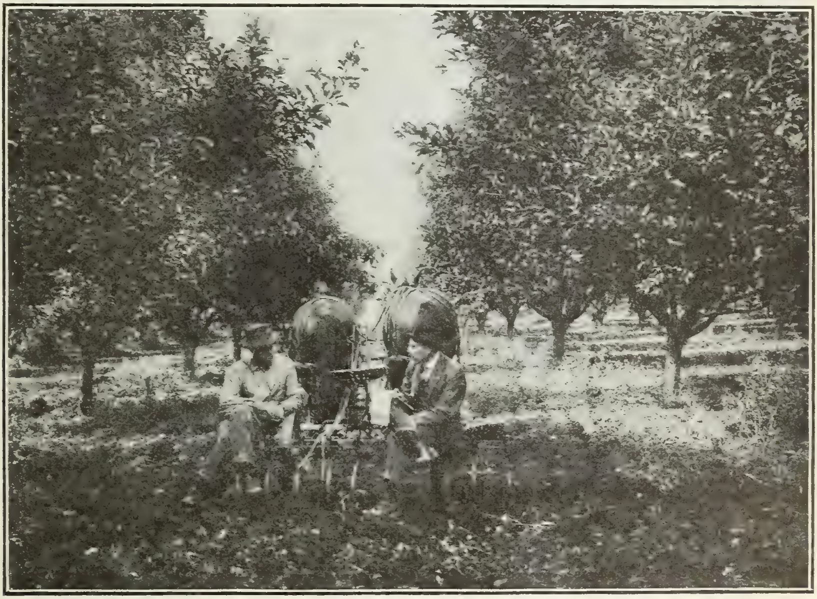


FIG. 4.—Type of cultivator commonly used in Yakima Valley orchards.

The soil in most of the apple orchards in Yakima Valley considered in this investigation is a sandy loam, friable and easy to work. Both climatic and soil conditions are such that cultivations may be commenced as early as the middle of March. The majority of the orchardists begin the work on the soil before the middle of April.

Forty-three of the 64 orchardists visited in the North Yakima district practiced clean cultivation. Twenty-nine, or 67.44 per cent of this number, made a practice of doing some plowing. Fifteen plowed every year, 8 every other year, 5 every three years, and 1 every four years. Of the 43 who practiced clean cultivation, the usual practice of 15 was to begin the annual cultivation with the plow, 7 with the disk harrow, 11 with the spring-tooth harrow, 4 with the spike-tooth harrow, 4 with a cultivator, and 2 with miscellaneous implements. Of the 15 who plowed annually, 13 plowed in the spring and 2 in the fall.

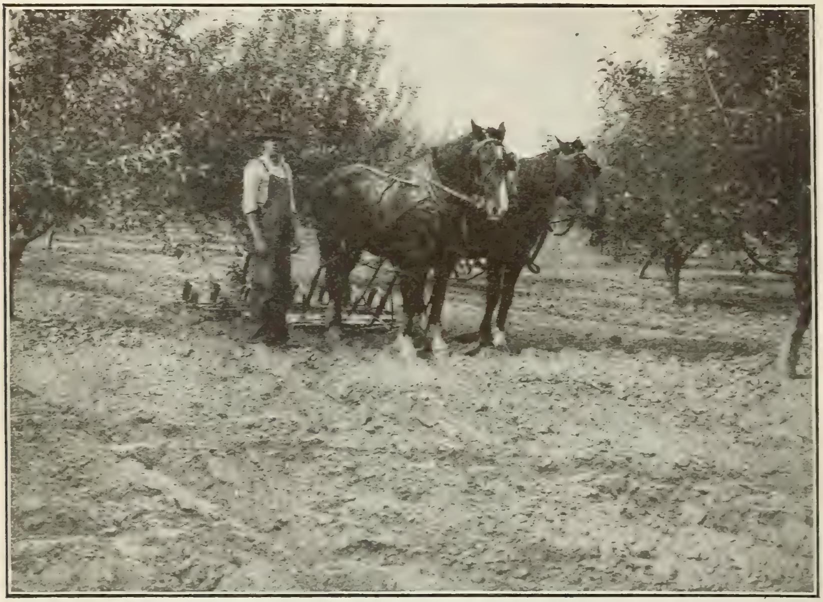


FIG. 5.—Cultivating by means of the spring-tooth harrow on one of the larger valley ranches.

TABLE XVII.—*Average time and cost per acre for various cultural operations in 75 orchards under clean-cultural management in Yakima Valley.*

Implement.	Crew.		Acres in 10 hours.	Cost per acre.
	Man.	Horse.		
Plow	1	2	1.58	$3.487
Disk harrow	1	2	5.18	1.062
Spring-tooth harrow	1	2	7.30	.754
Spike-tooth harrow	1	2	9.26	.594
6-foot cultivator	1	2	7.75	.710
Float	1	2	8.55	.644

The making of the deep dust mulch not only aids in the conservation of moisture but makes it possible for irrigation water readily to pass through the soil. As soon as the soil becomes packed and cracks open from improper care, irrigation water will not be taken up so readily. As soon as soil conditions permit, cultivations are made after each irrigation, usually until the middle of the summer or until the weight of the fruit bears the limbs down so as to interfere with cultivation. Following this first series of cultivations and before the first irrigation, furrows are made with a cultivator or shovel plow for distributing the water throughout the orchard.

Referring to Table XVIII it will be seen that the most intensive cultivation is done just before and following the earlier irrigations. There is an annual charge of 24.26 man-hours and 41.28 horse-hours, or a cost of $12.26, per acre for cultivation in orchards under clean-cultural management in the Yakima district.

Fifteen, or 46.88 per cent of the orchardists in the Zillah district used the plow for cultural purposes. (See Table XX). Of the 32 orchardists in the Zillah district who followed the clean-cultural practice 10, or 31.25 per cent, began the annual cultivation with the plow, 21 with the disk harrow, and 1 with the spring-tooth harrow. Of the 10 orchardists who plowed each year, 9 plowed in the spring and 1 in the fall. Spring plowing seems to be preferred by orchardists in both the North Yakima and Zillah districts.

TABLE XVIII.—*Percentage of orchardists making cultivations and the time chargeable per acre in 43 orchards under clean-cultural management in the North Yakima district.*

Operation.	Per cent of orchardists making various cultivations.	Hours per acre.		Per cent of total cultivation.
		Man.	Horse.	
Plowing	67.44	3.07	5.71	....
Cultivation:				
Before first irrigation	100	7.86	13.76	41.07
Following first irrigation	100	4.18	7.25	21.84
Following second irrigation	97.67	3.63	6.38	18.97
Following third irrigation	76.74	2.51	4.31	13.11
Following fourth irrigation	30.23	.91	1.65	4.75
Following fifth irrigation	2.33	.05	.10	.26
Total	....	19.14	33.45	100.00
Furrowing:				
Before first irrigation	....	1.31	1.98	....
Before second irrigation	....	1.31	1.98	....
Before third irrigation	....	1.24	1.89	....
Before fourth irrigation	....	.93	1.47	....
Before fifth irrigation	....	.33	.51	....
Before sixth irrigation	....	.00	.00	....
Total	....	5.12	7.83	....

TABLE XIX.—*Implements and the number of orchards in which each is used in 32 orchards under clean-cultural management in the Zillah district.*

When used.	Plow.	Disk harrow.	Spring-tooth harrow.	Spike-tooth harrow.	6-foot cultivator.	Cultivator.	Float.	Crease.
Before first irrigation	15	24	16	15	....	2	4	[1] 31
Following first irrigation	....	7	19	8	2	3	....	31
Following second irrigation	....	4	19	5	2	3	1	27
Following third irrigation	....	3	9	3	1	....	1	13
Following fourth irrigation	....	....	1	....	....	....	1	1
Following fifth irrigation	....	1	....	....	....	....	....	....

[1] One orchardist does not irrigate, therefore no creasing is made.

In Yakima many of the ranches are small and growers do not feel the necessity of having a variety of implements, but in the Zillah district the average ranch is larger, and many times other crops are grown, so that the individual growers usually have several different kinds of implements. The spring-tooth and disk harrows are by far the most common implement used for cultural purposes in the lower valley. (See fig. 5.)

Referring to Table XX, it will be noted that 97 per cent of the orchardists make a practice of cultivating after the first irrigation, 88 per cent following the second, and 44 per cent following the third. The orchardists in the Yakima district not only practice more intensive cultivation early in the season but continue it later in the season than do the orchardists in the Zillah region. Considering all the orchards which are clean cultivated in the Zillah district, there is an annual charge of 18.67 man-hours and 35.01 horse-hours, at a cost of $9.92 per acre.

That the size of the orchard and farm have some bearing on the amount of cultivation done is shown by Tables XXI and XXII.

TABLE XX.—*Percentage of orchardists making cultivations and the time chargeable per acre in 32 orchards under clean-cultural management in the Zillah district.*

Operation.	Per cent of orchardists making various cultivations.	Hours per acre.		Per cent of total cultivation.
		Man.	Horse.	
Plowing	46.88	2.45	4.89	
Cultivation:				
Before first irrigation	100	6.78	13.50	47.31
Following first irrigation	96.88	3.46	6.91	24.14
Following second irrigation	87.50	2.52	5.05	17.59
Following third irrigation	43.75	1.35	2.69	9.42
Following fourth irrigation	3.13	.14	.28	.98
Following fifth irrigation	3.13	.08	.16	.56
Total		14.33	28.59	100.00
Furrowing:				
Before first irrigation		1.30	1.98	
Before second irrigation		1.27	1.86	
Before third irrigation		1.10	1.65	
Before fourth irrigation		.58	.84	
Before fifth irrigation		.09	.09	
Before sixth irrigation				
Total		4.34	6.42	

TABLE XXI.—*Total time and cost chargeable per acre for cultivation in 43 orchards of various sizes under clean-cultural management in the North Yakima district.*

Number of records.	Acres in orchard.	Per acre.			Average acres in ranch.
		Man-hours.	Horse-hours.	Cost.	
31	1–5	26.23	42.85	$12.99	10.25
8	6–10	18.73	37.46	10.30	15.19
4	11–20	20.08	36.73	10.53	18.75

TABLE XXII.—*Total time and cost chargeable per acre for cultivation in 32 orchards of various sizes under clean-cultural management in the Zillah district.*

Number of records.	Acres in orchard.	Per acre.			Average acres in ranch.
		Man-hours.	Horse-hours.	Cost.	
13	1–5	21.07	39.86	$11.25	16.77
11	6–10	17.36	31.97	9.14	20.89
8	11–20	16.59	31.34	8.85	33.06

The intensiveness of cultivation varies to a considerable extent in each of these districts, but the figures indicate that costs of cultivation per acre in each district are higher for the orchards between 1 and 5 acres in size than for the larger orchards. Of course there is not any set rule as to the amount of cultivation which shall be done, but the whole plan of orcharding on small ranches in the Northwest tends toward intensiveness, and hence to a high cost of maintenance. On account of the small number of records for the larger orchards and ranches, it was impossible to bring out this fact as forcibly as was desired. Nevertheless, it would seem from the data that the smaller ranches and orchards tend toward more intensive methods.

The annual cost of cultivation on orchards of from 1 to 5 acres on ranches which average 10.25 acres in North Yakima was $12.99, while in the Zillah district, with orchards averaging approximately the same and with ranches which average 16.77 acres, the cost of cultivation is $11.25, and over $2 per acre more than on orchards of 6 to 10 acres in size where the ranches contain between 4 and 5 acres more.

TABLE XXIII.—*Average man-hours and horse-hours and cost chargeable per acre for cultivation, exclusive of plowing, in orchards under clean-cultural management in the Yakima Valley.*

District.	Number of records.	Average number of acres in orchard.	Per acre.			Cost per box.
			Man-hours.	Horse-hours.	Cost.	
North Yakima	43	5.49	24.26	41.28	$12.26	$0.0258
Zillah	32	7.70	18.67	35.01	9.92	.0236
North Yakima and Zillah	75	6.44	21.88	38.60	11.26	.0249

There is a total charge of 27.33 man-hours and 46.99 horse-hours, or $13.88 per acre, for all cultivation, including plowing, in orchards under clean-cultural management in the North Yakima district, and of 21.12 man-hours and 39.90 horse-hours, or $11.27 per acre, in the Zillah district. Table XXIII gives the cost chargeable per acre for cultivation exclusive of plowing in orchards under clean cultivation.

Considering the valley as a whole, there is a charge of $12.76 per acre for all cultivation, including plowing, or a packed-box charge of $0.0282.

MULCH CROP.

The term "mulch crop" in this connection refers to the practice of growing alfalfa, clover, and vetch in the orchard for hay or pasture.

Of the 120 orchardists from whom records were taken in the Yakima Valley, 45, or 37½ per cent, had sown their orchards to one of these shade or mulch crops. Alfalfa, however, is used most commonly.

Two rather distinctive methods of handling the mulch crop are practiced in the orchards of the valley. Some men cut and use the mulch crops for hay; others utilize the orchards for pasture. Of the 64 orchards in the North Yakima district, 21 have some mulch crop in their orchards; 19 of these use the mulch crop for hay, and 2 use it for pasture. Of the 24 orchardists in the Zillah district who use a mulch crop, 14 use the mulch for hay, 9 for pasture, and 1 leaves it on the ground. As alfalfa is the principal mulch crop grown by orchardists from whom records were obtained, this discussion will be confined entirely to the methods commonly practiced in the management of the orchards which were in this mulch crop.

In both districts where alfalfa is used for hay, the practice is to do some cultural work in the orchards. This is not necessarily done every year. A few of the orchardists make an annual practice of thoroughly disking the alfalfa as early as possible in the spring. This cuts the crowns and causes the plants to spread, producing new growth. An annual cultivation in the mulch-crop orchards is not common in the valley, only four orchardists in each district following this plan. The others allow it to remain in the orchard from two to four years. The orchard is then plowed, worked, and reseeded. Mulch-crop management is practically the same for both districts. (See Tables XXIV and XXV.)

The annual cultivation charge per acre of all orchards in the valley under clean-cultural management is 15.92 per cent of the total gross labor cost up to harvesting time, whereas in orchards under mulch-crop management it is only 6.06 per cent. In order to find the annual charge per acre on the orchards where cultivations are made only once in two to four years, the labor put on these orchards during the year of cultivation is prorated over the years when no cultivation is made. For example, if an orchard is plowed and cultivated once in four years, the annual charge per acre for labor will be one-fourth of the total labor done during the year of cultivation. Where all records are considered, regardless of the method of management of the soil, approximately 80 per cent of the total annual cultivation is made in both districts before the first irrigation.

Considering all mulch-crop records in the valley, whatever method of management is used, the annual charge per acre is 8.41 man-hours and 15.10 horse-hours, or a cost of $4.37 per acre, for cultivation.

In the hay-managed orchards two to three cuttings of alfalfa usually are made during the season.

TABLE XXIV.—*Percentage of orchardists making cultivations and the time chargeable per acre in 21 orchards under mulch-crop management in the North Yakima district.*

Operation.	Per cent of orchardists making various cultivations.	Hours per acre.		Per cent of total cultivation.
		Man.	Horse.	
Plowing	52.38	1.56	3.12	....
Cultivation:				
Before first irrigation	90.48	4.19	7.31	80.58
Following first irrigation	19.05	.41	.69	7.88
Following second irrigation	14.29	.28	.56	5.39
Following third irrigation	14.29	.32	.64	6.15
Total	....	5.20	9.20	100.00
Furrowing:				
Before first irrigation	....	1.92	2.76	....
Before second irrigation	....	.25	.30	....
Before third irrigation	....	.09	.15	....
Before fourth irrigation	....	.09	.15	....
Before fifth irrigation	....	....	....	....
Before sixth irrigation	....	.12	.12	....
Total	....	2.47	3.48	....

TABLE XXV.—*Percentage of orchardists making cultivations and the time chargeable per acre in 24 orchards under mulch-crop management in the Zillah district.*

Operation.	Per cent of orchardists making various cultivations.	Hours per acre.		Per cent of total cultivation.
		Man.	Horse.	
Plowing	41.67	0.84	1.68	....
Cultivation:				
Before first irrigation	62.50	3.09	6.18	79.23
Following first irrigation	20.83	.39	.78	10.00
Following second irrigation	8.33	.20	.40	5.13
Following third irrigation	8.33	.22	.43	5.64
Total	....	3.90	7.79	100.00
Furrowing:				
Before first irrigation	....	1.64	2.66	....
Before second irrigation	....	.55	.99	....
Before third irrigation	....	.43	.73	....
Before fourth irrigation	....	.27	.52	....
Before fifth irrigation	....	.06	.12	....
Total	....	2.95	5.02	....

The hay which is cut from the orchards is used generally for feed on the ranch. Many of the orchardists do not believe that this hay is as valuable for feeding purposes as alfalfa grown in the open field.

Table XXVI shows the prorated charge for harvesting the mulch crop, where all records are considered.

Considering all the records under mulch-crop management, the total annual labor charge per acre is $10.13. This includes cultivation, sowing, and harvesting of the mulch crop. Adding the cost of the seed makes $10.46 as a total annual labor and material charge per acre. There is an annual acre credit of $14.26 for the hay removed from the orchard and the value of the alfalfa when used in the orchard as a pasture. (See Pl. V.)

TABLE XXVI.—*Prorated charge for harvesting the mulch crop where 45 records are considered.*

District.	Number of records.	Per acre.				Value of hay.
		Man-hours.	Horse-hours.	Cost.	Yield in tons.	
North Yakima	21	24.76	12.80	$8.11	2.19	$16.58
Zillah	24	9.57	8.30	3.64	1.15	12.23
North Yakima and Zillah	45	16.66	10.40	5.73	1.63	14.26

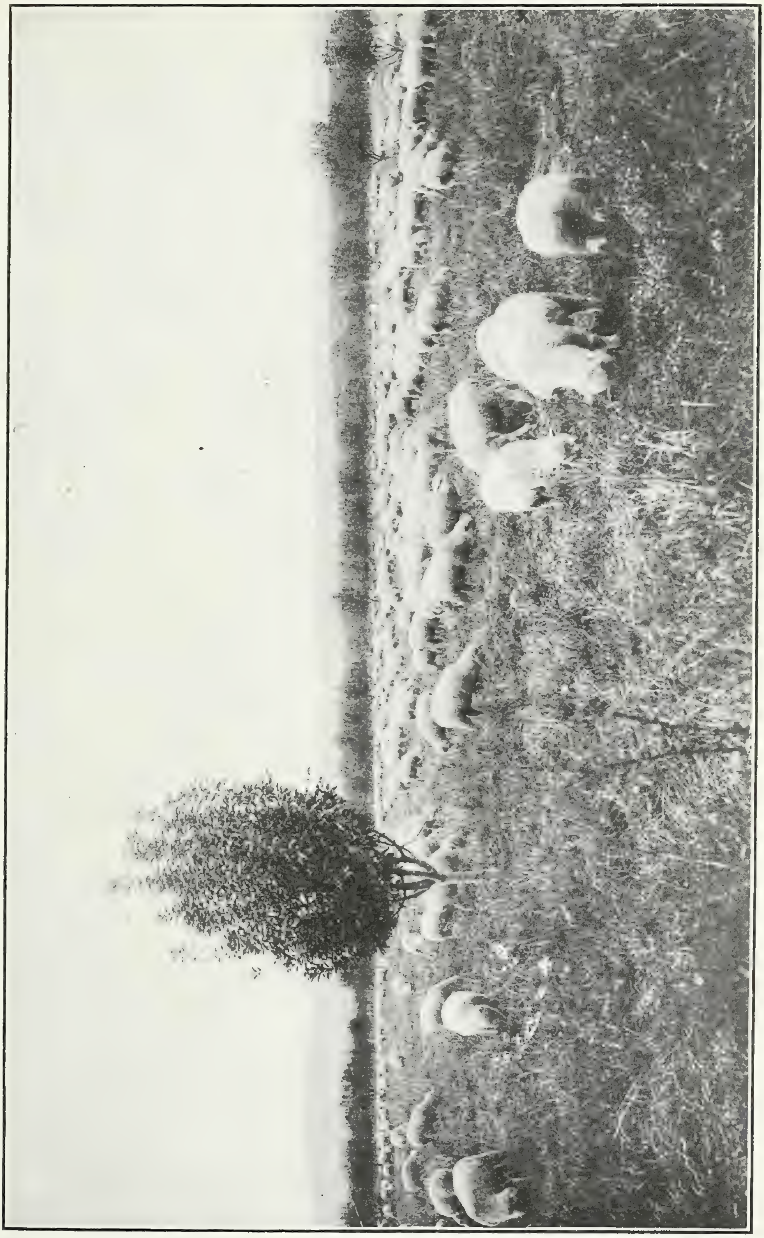
The estimated value per ton of hay given by the ranchers varies from $5 to $10. The majority in the North Yakima district, however, gave a value of approximately $8 per ton, those in the Zillah district gave a value of approximately $6 per ton. The estimated pasture value given in both districts varies considerably. However, the average value in the Zillah district, where a considerable number of men used a portion or all of their orchards for pasture, was estimated at approximately $10 per acre. (See Pl. V.) Where the 45 orchards under mulch-crop management are considered, the total annual labor and material charge is $10.46 per acre. The total annual hay and pasture credit is $14.26 per acre. Considering these two figures, the annual net credit is $3.80 per acre, or $0.0095 per box, on the 45 orchards under mulch-crop mangement. (See Table XXVII.)

TABLE XXVII.—*Annual prorated labor charge per acre up to harvesting time on 45 orchards in which alfalfa is used as a mulch crop.*

Operation, material, and credit.	Per acre.			Cost per box.
	Man-hours.	Horse-hours.	Cost.	
Cultivation	8.41	15.10	$4.37	$0.0110
Sowing mulch crop	.12		.03	.0001
Harvesting mulch crop	16.66	10.40	5.73	.0144
Total labor cost	25.19	25.50	10.13	.0255
Seed			.33	.0008
Total labor and material cost	25.19	25.50	10.46	.0263
Hay and pasture credit			14.26	.0358
Net credit			3.80	.0095

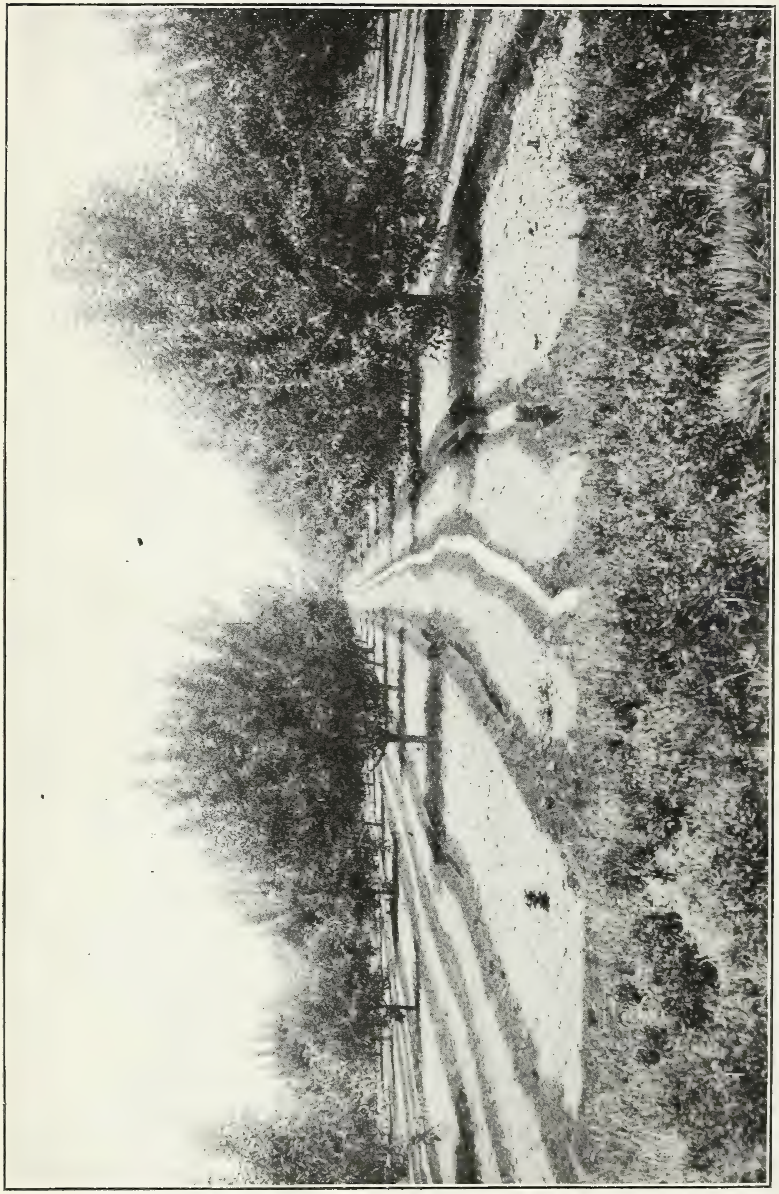
FURROWING.

Furrowing is a method of putting small furrows or "creases" in the orchards for the purpose of distributing the irrigation water. (See Pl. VI.) The most common implements used are the 6-foot



PASTURING SHEEP ON ALFALFA IN A YOUNG APPLE ORCHARD.

This is a common practice during October and November in this section.



IRRIGATING A 5-YEAR-OLD WINESAP ORCHARD NEAR NORTH YAKIMA, WASH.

In young orchards three furrows are often all that are necessary.

cultivator, shovel plow, and alfalfa marker. The cultivator and shovel plow are used most commonly in the North Yakima district. When the cultivator, which is usually 6 feet in width, is used for making creases, three shovels are attached—one at each end and one in the middle. A man and team constitute the crew. The trees of the valley are so set that with this implement six furrows 3 feet apart may be made comfortably in the space between the tree rows. These small furrows, usually four to six between tree rows, are 4 to 6 inches in depth. Often one or two cultivator teeth are placed between the shovels to loosen the soil between the furrows as they are being made. The 6- or 8-inch shovel plow is used by many orchardists, with either one or two horses. Where the trees are close together or the branches hang low, it often is necessary for one man to devote his entire attention to the plow while another man leads the horse. Orchardists often use a 1-horse shovel plow for making one or two furrows close to the tree row and then use either a 2-horse shovel plow or a 6-foot cultivator for making the other furrows. Ordinarily fewer creases are made between tree rows when the shovel plow is used than when the cultivator is used.

The alfalfa marker is a homemade implement. It is made by attaching a 4-inch shovel to the end of a 4 by 4 from 2 to 3 feet in length. Upon this 4 by 4 is made a platform on which the operator may ride. The small 4-inch shovel at the front end of the 4 by 4 breaks the soil as it is drawn by the team and the weight of the operator upon the platform forces the 4 by 4 into the ground, making a suitable furrow. The edges of the 4 by 4 which enter the ground are usually planed so that it will pass through the soil more easily. This implement is used most commonly in making furrows in alfalfa in the Zillah district.

The importance of furrowing in all clean-cultivated orchards of the valley is shown by the fact that its cost constitutes more than 20 per cent of the total cost of cultivation, exclusive of plowing. Records were obtained from 75 orchards under clean tillage, 74 of which practiced irrigation.

Furrows are made following each cultivation and before each irrigation until along in the midsummer, when cultivation ceases. After this last cultivation it is usually necessary to make only one set of furrows for any subsequent irrigations. Of the 74 orchardists in question, 12 made five creasings, 33 made four, 22 made three, 6 made two, and 1 made one.

In the clean-cultivated orchards 28 orchardists used the 6-foot cultivator and 41 the shovel plow (28 with a crew of one man and one horse and 13 with one man and two horses); 2 used the alfalfa marker, and 3, miscellaneous implements.

The most economical method of making furrows is with the 6-foot cultivator, using a crew of one man and two horses. (See fig. 6.) This crew will cover 9.9 acres in 10 hours, making the usual number of furrows, six, at a cost of $0.55 per acre. A little more time is required to make the furrows with the same size crew using a shovel plow, although fewer furrows are to be made between rows. A crew of one man and one horse with a shovel plow making the usual number of furrows, four, will cover 6.02 acres in 10 hours, at a cost of $0.67 per acre. Table XXVIII gives the average number of acres creased in 10 hours with different implements and crews.

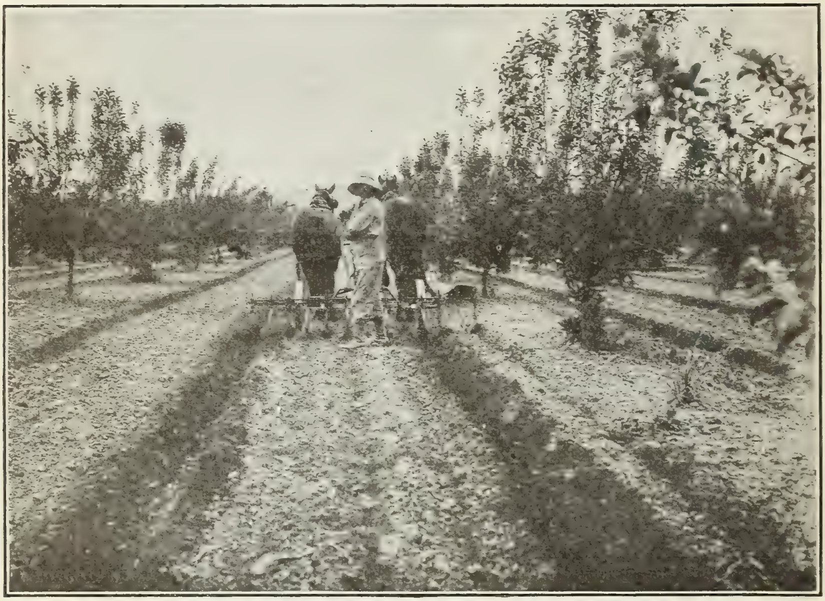


FIG. 6.—Furrowing out ditches for irrigating in a 4-year-old orchard in the Nob Hill section. The scarcity of leaves near the tops of the branches is due to rosette, a disease brought about by soil conditions.

TABLE XXVIII.—*Average number of acres creased with different crews and implements in 10 hours and the cost per acre.*

Implement.	Clean-cultural management.						Mulch-crop management.					
	Number of records.	Number of furrows.	Man.	Horse.	Acres in 10 hours.	Cost per acre.	Number of records.	Number of furrows.	Man.	Horse.	Acres in 10 hours.	Cost per acre.
6-foot cultivator	28	6	1	2	9.90	$0.55	5	6	1	2	10.99	$0.50
Shovel-plow	28	4	1	1	6.02	.67	16	5	1	1	5.75	.70
Do	13	5	1	2	7.30	.75	18	5	1	2	5.59	.98

Considering all records under clean-cultural management, whatever implement or crew is used, the annual charge for all creasings is 4.79 man-hours and 7.23 horse-hours per acre, at a cost of $2.27.

In the mulch-crop orchards of the Yakima district the annual charge for creasing is about 30 per cent of the total cultivation cost, exclusive of plowing, while in the Zillah district it is approximately 41 per cent. This difference is due to the fact that more cultivation is given alfalfa orchards of the Yakima district than those in the Zillah district.

In the mulch-crop orchards the number of creasings made varied considerably, just as was the case with the clean-cultivation orchards. However, the majority of men make only one creasing and this immediately following the early spring cultivation. A few, however, practice replacing the furrows after each cutting of alfalfa. Exceptions to this are noted, for 1 orchardist made five and 5 made four creasings. There were, however, 32 who made one, 5 who made two, and 2 who made three creasings in the orchards under mulch-crop management. It is often necessary to make extra creasings where orchards are constantly pastured, especially with hogs, which damage the furrows to a considerable extent.

The shovel-plow is the most common implement used in making furrows in the mulch-crop orchards in the valley. In the Yakima district it is customary to use a crew of one man and one horse, while in the Zillah district it is most common to use a crew on one man and two horses.

Considering all growers using mulch-crop management, 5 used the 6-foot cultivator for making creases, 36 used a shovel-plow, and 4 an alfalfa marker. So very few men used the 6-foot cultivator that the cost of making furrows with that implement in the mulch-crop orchards is not comparable with the cost where the same implement is used in clean-cultivated orchards. However, there were enough shovel-plow records to make figures for that implement comparable. Referring to Table XXIX, it would seem that in both cases the cost of making furrows in the mulch-crop orchards is somewhat lower than in the orchards under clean-cultural management. Considering all records under mulch-crop management, the total charge for creasing is 2.73 man-hours and 4.30 horse-hours per acre, at a cost of $1.33.

TABLE XXIX.—*Total man-hours and horse-hours chargeable and the cost per acre for all creasings where 120 records are considered.*

District.	Clean-cultural management.			Mulch-crop management.		
	Man-hours.	Horse-hours.	Cost per acre.	Man-hours.	Horse-hours.	Cost per acre.
North Yakima	5.12	7.83	$2.45	2.47	3.48	$1.14
Zillah	4.34	6.42	2.05	2.95	5.02	1.49
North Yakima and Zillah	4.79	7.23	2.27	2.73	4.30	1.33

In the North Yakima district the principal sources of water supply for irrigation are the Naches River and Cowiche Creek. The water is brought to various parts of the district through canals or ditches, from which it is led through open ditches to the individual ranches, where it is distributed through the orchards by means of furrows. (See Pl. VI.)

Private pipe lines for the purpose of conserving as much water as possible have been installed in some instances by individual growers, particularly on the higher lands in the Nob Hill district, and there is a growing tendency on the part of the ranchers in the North Yakima district to follow this custom. This practice has nothing to do with the general maintenance of the canal as a whole, and the expense, which obviously will vary greatly, is borne entirely by the individual owners. In this study such an investment is considered as part of the land and improvement value.

The basis of water distribution under the different ditches varies from 33 to 80 acres per second-foot, and all stockholders under a given canal pay exactly the same assessments for the same amount of water. In some instances growers may use less water per acre than usual on a larger amount of land—that is, one-half inch (miner's) per acre instead of 1 inch per acre. This, however, is the exception. The customary rate of distribution is as given above in the second-foot.

In the Zillah district the majority of ranchers received their supply of irrigation water through a Government canal, known locally as the Sunnyside Canal. The water is delivered from the main ditch through open ditches or wooden flumes to the ranches. Flumes are often used in the orchards and usually are placed along the higher parts or ridges of the land so that the water may be distributed more easily throughout the orchard.

These flumes in the orchard are temporary and can be removed to permit cultivation or other orchard operations. Usually they are made of 8- to 12-inch boards, ½ to 1 inch thick, and of varying lengths. Along these boxlike forms or flumes holes are made through which the water is allowed to flow for distribution. These holes usually are covered with a small piece of tin or lath, which is used to regulate the flow of water. There is a tendency in some instances in this district to substitute underground piping for open ditches and flumes. The water in both the North Yakima and Zillah districts is distributed through the orchard by means of furrows. Very few orchardists in the valley practice the flooding method.

The maintenance charge or water tax may vary greatly from year to year. Often high assessments are made for permanent improvements or to cover the expense of litigation. The ranchers in the North Yakima district from whom data were obtained paid annually a water tax from $0.75 to $6 per acre. The prorata[1] cost in this district for water tax is $3.10 per acre. The maintenance charge or tax per acre in the Zillah district on the Government ditch is $1. The prorata cost in this district for water tax is $0.86 per acre. The unit of measure for water is an inch (miner's) per acre. The average prorata maintenance charge per acre for water in the valley (120 records) is $2.06.

TABLE XXX.—*Time chargeable and the labor cost per acre for irrigation on 120 orchards of different acreages in Yakima Valley.*

Acres in orchard.	North Yakima district.				Zillah district.				North Yakima and Zillah districts.			
	Number of records.	Number of irrigations.	Man-hours.	Cost per acre.	Number of records.	Number of irrigations.	Man-hours.	Cost per acre.	Number of records.	Number of irrigations.	Man-hours.	Cost per acre.
1-5	46	4.62	21.65	$5.41	20	3.50	17.83	$4.46	66	4.28	20.49	$5.12
6-10	14	4.43	13.54	3.39	24	4.00	14.43	3.61	38	4.16	14.10	3.53
11-20	4	3.75	14.92	3.73	12	3.42	12.84	3.21	16	3.50	13.36	3.34
1-20	64	4.52	19.45	4.86	56	3.70	15.30	3.83	120	4.14	17.52	4.38

The first irrigation on apple orchards in the valley is made usually in the latter part of April or the first part of May, depending to a great extent on the moisture present in the soil. The number of irrigations made by the individual ranchers varies considerably throughout the valley. An irrigation is made usually every four to six weeks throughout the season, in both clean and mulch-crop orchards, some men irrigating as late as the 1st of September. Data for the North Yakima district show an average of 4.52 irrigations, and for the Zillah district an average of 3.70 irrigations.

The water is allowed to run in one place in the orchard from 24 to 72 hours, the time varying to a considerable extent with the type of soil. Usually the water is kept running till the widening zones of saturation meet between furrows. The length of time the water is allowed on one place is governed also by the head of water in the ditch. At the time of the first irrigation it often requires a longer period to saturate the soil than later. The length of time for each irrigation is governed also to a considerable extent by the contour of the land, which in turn governs somewhat the length of the furrows used for carrying the water. On hilly lands the length of the ditches is reduced to avoid washing of the soil. An orchardist may have to spend all of his time on irrigation the first few days early in the season, but on the average it requires for the season but from one to three hours per day on the average-size apple orchard in the Yakima Valley. Table XXXI gives the labor cost and the pro rata cost for water maintenance.

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[1] "Prorata" cost is the actual cost distributed over all records.

The comparatively large cost reported for the mulch-crop orchards in the North Yakima district is due to the fact that a larger number of the ranches happened to be on a ditch where the cost of water maintenance is high. In the Zillah district the charge for water on the Sunnyside Canal is less than for most of the ditches in the North Yakima district. The difference here in the cost of maintenance between the mulch-crop and clean-cultural orchards is due to the fact that many orchardists practicing clean-cultural management from whom data were obtained are on the Konawak Canal and have a free water right. There is little difference between the number of irrigations made on mulch-crop and on clean-cultural orchards, although there seems to be a slight tendency (see Table XXXI) to make more irrigations on the mulch-crop orchards. More labor, however, is expended in looking after the irrigation on clean-cultural than on mulch-crop orchards. Table XXX brings out the fact that in both the North Yakima and Zillah districts more time is used in examining the ditches and regulating the water on the small than on the large orchards.

Considering the records from both clean and mulch-crop orchards in the North Yakima district, there is an average of 4.52 irrigations, requiring 19.45 man-hours per acre, at a cost of $4.86; while in the Zillah district there is an average of 3.70 irrigations, requiring 15.30 man-hours per acre, at a cost of $3.83. For the entire valley the records show an average of 4.14 irrigations, requiring 17.52 man-hours per acre, at a cost of $4.38.

TABLE XXXI.—*Time chargeable for irrigation and pro rata water tax per acre for 120 farms in Yakima Valley.*

Management.	North Yakima district.					Zillah district.				
	Number of irrigations.	Man-hours.	Labor cost.	Water tax.	Total cost.	Number of irrigations.	Man-hours.	Labor cost.	Water tax.	Total cost.
Clean cultural	4.50	20.30	$5.08	$2.66	$7.74	3.66	16.07	$4.02	$0.81	$4.83
Mulch crop	4.57	17.72	4.43	4.01	8.44	3.80	14.28	3.57	.92	4.49
Combined	4.52	19.45	4.86	3.10	7.96	3.70	15.30	3.83	.86	4.69

Management.	North Yakima and Zillah districts.				
	Number of irrigations.	Man-hours.	Labor cost.	Water tax.	Total cost.
Clean cultural	4.14	18.50	$4.63	$1.87	$6.50
Mulch crop	4.13	15.89	3.97	2.36	6.33
Combined	4.14	17.52	4.38	2.06	6.44

THINNING.

Thinning is an annual practice of all orchardists visited in the valley. (See fig. 7.) Usually it is begun during the month of June, shortly after what is known as the "June drop." The time required for this operation varies much, depending on the size of the crop, the variety, age, and size of tree, and the method adopted in thinning.

The usual practice is to thin so that the fruit is well distributed over the tree. No set rule can be given, although the growers aim to leave only one apple in a place, partly for the reason that where two apples touch each other a favorite opportunity is offered for the codling-moth larva to work. The amount of thinning depends to a considerable extent upon the season. If the crop is light and the apples are borne in clusters, two apples sometimes are left in a place; but with a heavy crop and varieties which tend to small size, many make a practice of thinning to 6 or 8 inches. Needless to say, with a large crop the work of thinning will be doubled or even trebled. Many times it is necessary to do more than one thinning during the season, this being especially true of red varieties. Practically all thinning throughout the valley is done with thinning shears. The trees are of such size and age that most of the work may be done from the ground or from an 8- to 10-foot stepladder.

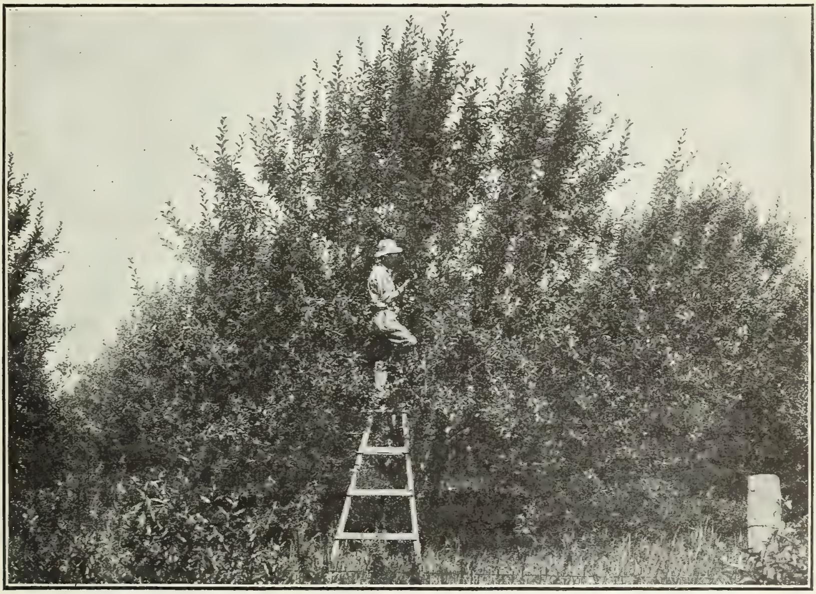

FIG. 7.—Thinning a 7-year-old Winesap tree in the Zillah district. Alfalfa is used as an intercrop and mulch crop here. Note the size of tree for its age.

The amount of thinning is governed not only by the size of the crop but by the amount of pruning that is done. The cost of thinning operations in the valley is 18.38 per cent of the total gross labor cost previous to harvesting time, and second only to the cost of pruning, which is 19.55 per cent. Considering all the records in the Yakima district, the thinning cost is 13.81 per cent of the total gross labor cost up to harvesting time, and in the Zillah district it is 23.22 per cent.

TABLE XXXII.—*Cost of thinning in orchards in the Yakima Valley.*

District.	Number of records.	Average number of acres in orchard.	Trees per acre.	Man-hours per acre.	Cost.		
					Per acre.	Per tree.	Per box.
Under clean-cultural management:							
North Yakima	43	5.49	79.21	37.34	$9.33	$0.12	$0.0196
Zillah	32	7.70	69.07	72.43	18.11	.26	.0430
North Yakima and Zillah	75	6.44	74.88	52.31	13.08	.17	.0289
Under mulch-crop management:							
North Yakima	21	4.52	76.26	32.51	8.13	.11	.0187
Zillah	24	7.85	67.03	55.04	13.76	.21	.0375
North Yakima and Zillah	45	6.30	71.33	44.53	11.13	.16	.0280
All orchards:							
North Yakima	64	5.18	78.24	35.76	8.94	.11	.0190
Zillah	56	7.77	68.19	64.98	16.24	.24	.0410
North Yakima and Zillah	120	6.39	73.55	49.39	12.35	.17	.0286

It would seem from Table XXXII that thinning is done more thoroughly in the Zillah district than elsewhere in the valley. This fact is borne out by the propping tables, which show that propping takes more time in the North Yakima than in the Zillah district. The men in the Zillah district thin as thoroughly as possible in order to obviate a considerable amount of propping.

The amount of thinning required on the clean-cultivated orchards is more than that on the orchards under mulch-crop management. No doubt this is due to the larger yield of the orchards under the former method of management.

Considering all orchards from which data were obtained in the valley, an average of 49.39 man-hours is required for thinning, at a cost of $12.35 per acre, or $0.0286 per box.

PROPPING.

Propping is an annual practice of 60 per cent of the orchardists from whom records were obtained. It is governed to a great extent by the amount of pruning and thinning done. Most of the orchardists are beginning to make a more thorough thinning in order to obviate the necessity of so much propping. This, as has been noted, is especially true in the Zillah district. The cost of thinning for the Zillah district is more than twice as large as that for the North Yakima district, but the cost of propping is much lower. It was found that 75 per cent of the orchardists under consideration in the North Yakima district practice some propping each year, but only 43 per cent followed the practice in the Zillah district.

Propping (see Table XXXIII) is done any time throughout the latter part of the growing season when the weight of the fruit has a tendency to bear the limbs down so that there is danger of their breaking. The props usually are made of 2- by 3- inch or 1- by 4- inch strips between 8 and 12 feet in length, so notched at one end as to hold up the limbs securely. The propping is done as the need presents itself. Pine and fir props may be obtained for $15 to $20 per thousand feet. The amount of depreciation will vary to a considerable extent, depending upon the care given them. Many of the growers believe that, with proper handling and shelter, these props would last from 10 to 15 years.

Table XXXIII.—*Number of man-hours and horse-hours and cost per acre required for propping orchards in the Yakima Valley.*

District.	Number of records.	Per acre.				Cost per tree.	Per cent propping.
		Trees.	Number of man-hours.	Number of horse-hours.	Cost.		
Under clean-cultural management:							
North Yakima	43	79.2	5.32	4.61	$2.02	$0.026	79.07
Zillah	32	69.1	2.93	3.12	1.20	.017	50.00
North Yakima and Zillah	75	74.9	4.30	3.98	1.67	.022	66.67
Under mulch-crop management:							
North Yakima	21	76.3	4.85	3.99	1.81	.024	66.67
Zillah	24	67.0	2.65	2.51	1.04	.016	33.33
North Yakima and Zillah	45	71.3	3.67	3.20	1.40	.020	44.44
All orchards:							
North Yakima	64	78.2	5.16	4.41	1.95	.025	75.00
Zillah	56	68.2	2.81	2.86	1.13	.017	42.86
North Yakima and Zillah	120	73.6	4.06	3.69	1.57	.021	60.00

Several methods of handling props are practiced. On smaller plantings some men carry their props into the orchard and prop where needed. Others use a team for hauling out the props, placing them in convenient piles throughout the orchard. Setting up props is a separate operation. Many of the men haul the props out and set them as the hauling is being done. When these props are hauled, a crew of one man and two horses is used ordinarily. So few men followed any one particular method that it is impossible to give a fair average for any particular crew in performing this operation.

As a rule, after the season is over the props are hauled and piled in a sheltered place. Few men allow their props to remain in the orchard. A little more time is required for this operation in the clean-cultured than in the mulch-crop orchards, owing mostly to the difference in yield.

Considering all records that were taken, regardless of the method used, the annual propping charge is 4.06 man-hours and 3.69 horse-hours, at a cost of $1.57 per acre.

SPRAYING.

Spraying is an annual practice. The need of careful and systematic spraying is felt by practically all the growers of the valley, for it is realized that only by persistently following such practice can the production of marketable apples be guaranteed. The average spraying cost of labor and material for all of the orchardists considered in this study is $25.14 per acre, or 7.27 per cent of the net cost of production.

The orchardists considered in this investigation make an average of four sprays per year. Some make as many as seven applications, the number varying with the abundance of insect pests and the prevalence of fungus diseases. The majority of growers make a dormant or lime-sulphur spray and three lead-arsenate sprays.

The codling moth is one of the worst pests with which the orchardists in the valley have to contend. For this reason a few of the orchardists practice making two calyx sprays, one immediately following the other. This is done because of the irregularity in blossoming of the different varieties and also to make a more thorough application of material for protection against the codling-moth larvæ.

It is the practice of most growers to make lead-arsenate sprays only on trees which promise to yield part or the whole of a crop. Often small strips of rags, or markers, are tied to the trees which are to be sprayed. In this way considerable time can be saved. However, this practice may result in the survival of a number of codling-moth larvæ in the unsprayed trees.

On account of the appearance of the apple powdery-mildew, a few of the orchardists are beginning to use atomic sulphur for its control. In some years also the apple aphids cause considerable damage. A few of the growers use tobacco extract, whale-oil soap, and other contact sprays for their control, but a spray of this kind was not general at the time of this study.

Since so few growers were making an annual practice of applying any material for the control of apple powdery-mildew or aphis, no discussion is made of methods practiced. However, the cost of these sprays is taken into account where they are made and is given in Table XXXVI.

It would seem from conditions prevalent at the time of the study that the growers of the valley will find it necessary to use some preventive measures against both the apple powdery-mildew and the aphis.

The spraying crew usually consists of three men and two horses. In the North Yakima district 55 of the 64 orchardists used such a crew, 7 used a crew of two men and two horses, 1 a crew of two men and one horse, and 1 man used a stationary engine and pump. In the last case the orchard contained 3 acres and the operator himself did all the spraying.

In the Zillah district, 50 orchardists visited used for spraying a crew of three men and two horses, 5 a crew of two men and two horses, and 1 a crew of four men and two horses. In the valley as a whole, 105 used a crew of three men and two horses in spraying. With this crew, one man usually does the driving and tends the engine, leaving one man for each lead of hose to do the spraying. Since most of the orchardists used a crew of three men and two horses, *all the discussion on spraying will pertain to an outfit with this number in the crew unless otherwise stated.*

Gasoline engines used for spraying purposes vary from 1½ to 4 horsepower. The complete outfit usually consists of a gasoline engine, a spray tank varying in capacity from 150 to 200 gallons, and two 50-foot leads of spray hose. Bamboo rods with a single nozzle attachment complete the outfit. But few orchardists use two nozzles on a lead. Nozzles of the Bordeaux type are the most popular and a pressure of 200 to 300 pounds is used ordinarily in making all sprays. Few growers feel the necessity of using a spray tower, although the use of towers is encouraged.

Eighty-three of the growers considered in this investigation owned spray outfits and 37 hired their spraying done. Where spraying was hired, $1 an hour was paid for the spray outfit, team and one operator. Considering the man- and horse-labor at $0.25 and $0.15 per hour, respectively, there is left a machine charge of $0.45 per hour. The machine-hours per acre for hired outfits are 9.62, and the machine cost per acre $4.33.

The owned spray outfits are considered as a part of the farm equipment and the annual charge for their use is included in the equipment charge, while the machine charge for hired outfits is given as a separate item. Both appear under fixed costs.

DORMANT SPRAY.

A dormant or lime-sulphur spray is made usually in the latter part of March or the 1st of April. Many of the orchardists have a tendency to delay this spray until the fruit buds begin to show their green tips. This spray is made usually with a 1–10 solution—that is, 1 gallon of concentrated solution of lime and sulphur to 10 gallons of water. A number of the orchardists are beginning to use miscible oils for the dormant spray.

All orchardists visited in the valley make the dormant spray. Of the 105 who used a crew of three men and two horses, 69 own spray outfits and 36 hire their spraying done. (See Table XXXIV.) By referring to Table XXXIV, in the lime-sulphur spray, it will be noted that the former spray about an acre less per day and apply nearly 80 gallons more per acre than the latter, making a total labor and material cost of $2.03 more per acre for those who own their outfits than those who hire.

Twenty-five orchardists in the North Yakima district spray with their own outfits and 30 hire their spraying done, while in the Zillah district 44 spray with their own outfits and 6 hire their spraying done.

TABLE XXXIV.—*Summary of spraying with a crew of three men and two horses, with owned and hired spray rigs, on 105 farms studied in the Yakima Valley.*

OWNED SPRAY RIGS.

District and spray.	Number making sprays.	Acres in 10 hours.	Gallons.		Cost.		
			Per acre.	Per tree.	Labor.	Material.	Total.
North Yakima:							
Lime-sulphur	25	3.24	479.62	6.44	$3.24	$6.86	$10.10
Calyx or first lead-arsenate	25	3.37	486.82	6.53	3.12	1.70	4.82
Second lead-arsenate	21	3.58	411.04	5.50	2.93	1.43	4.36
Third lead-arsenate	15	4.36	315.90	4.18	2.41	1.15	3.56
Fourth lead-arsenate	25	3.74	401.01	5.38	2.81	1.41	4.22
Fifth lead-arsenate	8	3.29	419.38	5.41	3.19	1.62	4.81
Zillah:							
Lime-sulphur	44	3.41	464.31	6.84	3.08	6.61	9.69
Calyx or first lead-arsenate	44	3.57	483.32	7.21	2.95	2.01	4.96
Second lead-arsenate	33	3.77	459.87	6.81	2.79	1.85	4.64
Third lead-arsenate	41	3.72	447.15	6.56	2.82	1.82	4.64
Fourth lead-arsenate	44	3.81	432.26	6.45	2.75	1.75	4.50
Fifth lead-arsenate	27	4.14	399.79	5.82	2.53	1.66	4.19
Sixth lead-arsenate	6	5.15	301.07	4.57	2.04	2.03	4.07
North Yakima and Zillah:							
Lime-sulphur	69	3.34	469.87	6.68	3.14	6.70	9.84
Calyx or first lead-arsenate	69	3.49	484.59	6.95	3.01	1.90	4.91
Second lead-arsenate	54	3.69	440.88	6.27	2.85	1.71	4.56
Third lead-arsenate	56	3.88	411.99	5.87	2.71	1.64	4.35
Fourth lead-arsenate	69	3.79	420.93	6.04	2.77	1.63	4.40
Fifth lead-arsenate	35	3.91	404.27	5.72	2.68	1.65	4.33
Sixth lead-arsenate	6	5.15	301.07	4.57	2.04	2.03	4.07
HIRED SPRAY RIGS.							
North Yakima:							
Lime-sulphur	30	4.38	397.97	4.88	$2.40	$5.50	$7.90
Calyx or first lead-arsenate	30	4.50	408.22	5.01	2.33	1.42	3.75
Second lead arsenate	24	5.59	332.71	4.09	1.88	1.08	2.96
Third lead-arsenate	14	4.87	365.76	4.43	2.16	1.34	3.50
Fourth lead arsenate	28	5.26	335.05	4.12	2.00	1.13	3.13
Fifth lead-arsenate	6	4.25	382.78	4.26	2.47	1.43	3.90
Zillah:							
Lime-sulphur	6	4.24	353.71	4.50	2.48	4.73	7.21
Calyx or first lead-arsenate	6	4.65	318.43	4.05	2.26	1.36	3.62
Second lead-arsenate	4	4.42	382.16	4.42	2.37	1.64	4.01
Third lead-arsenate	3	6.01	239.63	3.20	1.75	1.14	2.89
Fourth lead-arsenate	6	4.75	338.80	4.31	2.21	1.48	3.69
Fifth lead-arsenate	4	4.72	321.69	3.66	2.23	1.32	3.55
Sixth lead-arsenate	2	8.93	155.88	1.63	1.18	.84	2.02
North Yakima and Zillah:							
Lime-sulphur	36	4.35	390.59	4.82	2.41	5.40	7.81
Calyx or first lead-arsenate	36	4.52	393.26	4.85	2.32	1.41	3.73
Second lead-arsenate	28	5.39	339.67	4.14	1.95	1.16	3.11
Third lead-arsenate	17	5.03	343.50	4.23	2.09	1.31	3.40
Fourth lead-arsenate	34	5.16	335.71	4.15	2.03	1.19	3.22
Fifth lead-arsenate	10	4.42	358.34	4.03	2.37	1.38	3.75
Sixth lead-arsenate	2	8.93	155.88	1.63	1.18	.84	2.02

Considering all records in the valley, regardless of crew or whether the spray outfit is owned or hired, the total labor and material cost for the lime-sulphur spray is $8.81 per acre, or 35.04 per cent of the total labor and material spraying cost. (See Table XXXVI.)

LEAD-ARSENATE SPRAYS.

Usually three or four lead-arsenate sprays are made for the control of the codling moth. Some growers find it necessary to make as many as six sprays. Throughout the valley there is considerable variation in the time that the calyx spray is applied. This is due primarily to differences in altitude and season. In 1913 it was applied between April 22 and 27; in 1914, April 20 and 25; in 1915, April 25 and 30; and in 1916, April 27 and May 2. Lead-arsenate paste is used by the majority of orchardists for these sprays. From 1½ to 3 pounds of this paste is used in 50 gallons of water.

The calyx or first lead-arsenate spray.—The calyx spray is considered by the majority of orchardists to be the most important. All make it about the time that 75 to 90 per cent of the petals have fallen. By referring to Table XXXIV it will be seen that the same number of owned and hired outfits were used in this spray as in the dormant spray. The former averaged about an acre less in 10 hours and applied about 90 gallons per acre more than the latter, making a total labor and material cost of $1.18 more per acre for those who own outfits than those who hire. More material is usually applied per tree in this spray than in any of the others, at least by the better class of commercial growers. The total labor and material cost per acre for the calyx spray in the North Yakima district (55 orchards) was $4.24, while in the Zillah district (50 orchards) it was $4.77. Considering all records, whatever size of crew or whether the spray outfit is owned or hired, the total labor and material cost per acre for the calyx spray was $4.47, or 17.78 per cent of the total labor and material spraying cost. (See Table XXXVI.)

Second lead-arsenate spray.—The second lead-arsenate spray is usually made from three to four weeks after the calyx spray. The date of application will vary with the season. It is usually between the 11th and the 25th of May, but sometimes as late as the first of June. The purpose is to poison the codling-moth larvæ, which are beginning to hatch at this time. This spray was made by 78 per cent of the growers considered in this investigation. As in the former sprays, it will be seen that the cost per acre for labor and material is greater for those who own their outfits than those who hire, and that more of the orchardists in the North Yakima district hire their spraying done. The total labor and material cost for the North Yakima district (45 orchards) was $3.64 per acre; while in the Zillah district (37 orchards) it was $4.57. Considering all records, regardless of crew or whether the spray outfit is owned or hired, the total labor and material cost per acre for the second lead-arsenate spray was $3.09, or 12.29 per cent of the total labor and material spraying cost. (See Table XXXVI.)

Third lead-arsenate spray.—The third lead-arsenate spray is made from 10 to 15 days after the second codling-moth spray. This spray was made by 72 per cent of the growers visited. In this spray, as in the second lead-arsenate, there is about an acre more done per day by hired than by owned outfits, but less material is applied per acre. It is obvious from the figures that the difference in cost between the owned and hired outfits in this spray is somewhat less than in the former sprays. The necessity of a thorough application of material is not felt so keenly by the growers as in the previous sprays, for up to and including this spray there is a gradual increase in the amount of ground covered per day, and a decrease in the material applied per acre, especially where the spraying is done by the owners themselves. The total labor and material cost for the North Yakima district (29 orchards) was $3.53; while in the Zillah district (44 orchards) it was $4.52 per acre. Considering all records, regardless of crew used or whether the spray outfit is owned or hired, the total labor and material cost per acre for the third lead-arsenate spray was $2.89, or 11.50 per cent of the total labor and material spraying cost. (See Table XXXVI.)

Fourth lead-arsenate spray.—The fourth lead-arsenate spray is usually made from 9 to 10 weeks after the calyx spray. One hundred and eighteen orchardists visited, or 98 per cent, used this spray. From the number of orchardists who make this spray, together with the amount of material applied and the labor required, it appears that this spray is the second most important codling-moth spray. Table XXXIV shows the number of acres sprayed per day and the material applied per acre for both hired and owned outfits. The cost per acre for labor and material was $1.18 more for those who owned outfits than those who hired. Total labor and material cost in the North Yakima district (53 orchards) for this spray was $3.64; while in the Zillah district (50 orchards) it was $4.40. Considering all records, whatever size of crew used or whether the spray outfit is owned or hired, the total labor and material cost per acre for the fourth lead-arsenate spray was $3.85, or 15.32 per cent of the total labor and material spraying cost. (See Table XXXVI.)

Fifth lead-arsenate spray.—The time for the fifth spray is usually the early part of August. It is made by 41 per cent of the growers considered in this study. Thirty-five orchardists owning, and ten hiring outfits made this spray, each using a crew of three men and two horses. From Table XXXIV it will be seen that the cost per acre for labor and material is $0.58 more for those who own outfits than those who hire. Considering all records for the valley, regardless of crew or whether the spray outfit is owned or hired, the total labor and material cost for the fifth lead-arsenate spray was $1.74, or 6.92 per cent of the total labor and material spraying cost. (See Table XXXVI.)

Sixth lead-arsenate spray.—The sixth lead-arsenate spray, usually applied during the latter part of August or the first of September, depending upon the season, was made by 8 per cent of the growers considered in this study. Because so few of the orchardists in the valley made this spray, the comparison of the figures in Table XXXIV should not ordinarily be made. It was necessary, however, to use them in order to arrive at the total cost of spraying for these 120 records. In considering all records for the valley, whatever the size of crew, and whether the spray outfit is owned or hired, the total labor and material cost for the sixth lead-arsenate spray was $0.29, or 1.15 per cent of the total labor and material spraying cost. (See Table XXXVI.)

SUMMARY OF SPRAYING PRACTICES.

There is a tendency in the valley to make a more thorough application of material on orchards under clean-cultural management than on those under mulch-crop management. Where owned outfits are used on such orchards, more material is applied per acre, fewer acres are sprayed per day, and the average total labor and material cost is greater than where owned outfits are used on mulch-crop orchards. However, where hired outfits are used on orchards under clean-cultural management less material is applied, more acres are sprayed per day, and the total labor and material cost is less per acre than where such outfits are used on orchards under mulch-crop management. As results from the owned outfits are better as a basis for comparison, it would seem that orchards under clean-cultural management received a more thorough application of spray material. This is brought out more clearly by making a comparison of all orchards where spraying is done with owned outfits with those where hired outfits are used. (See Table XXXIV.)

It is found that for practically all the orchards studied more acres are sprayed per day with a hired outfit, less material is applied per acre, and the total labor cost is less than where the outfit is owned. Comparing the North Yakima and the Zillah districts, it is found that with owned outfits more acres are sprayed in 10 hours and more material is applied per acre and per tree in the Zillah district. Considering the 120 orchards, the average cost for spraying labor and material is $0.0256 more per box than in the North Yakima district. The pro rata labor cost for spraying, considering all records for the valley, was $12.93, and the material pro rata cost was $12.21 per acre, making a total of $25.14 per acre, or $0.0582 per box. (See Table XXXV.)

TABLE XXXV.—*Summary of spraying expenditures on 120 farms in Yakima Valley, by districts.*

Item.	North Yakima district.	Zillah district.	North Yakima and Zillah districts combined.
Man-hours per acre	31.99	42.07	36.69
Horse-hours per acre	21.78	28.85	25.08
Labor cost per acre	$11.26	$14.84	$12.93
Material cost per acre	$10.55	$14.12	$12.21
Total cost per acre	$21.81	$28.96	$25.14
Gallons of material per acre	1,773.09	2,364.69	2,049.17
Gallons of material per tree	22.67	34.67	27.84
Labor cost per box	$0.0243	$0.0372	$0.0299
Material cost per box	.0228	.0355	.0283
Total cost per box	.0471	.0727	.0582

TABLE XXXVI.—*Summary of spraying practices and pro rata cost by sprays on farms studied in Yakima Valley.*

Spray.	Number making spray.	Per acre.			Gallons.		Material cost per acre.	Total cost per acre.	Per cent of total labor and material spraying cost.
		Man-hours.	Horse-hours.	Cost.	Per acre.	Per tree.			
Lime-sulphur	120	7.89	5.37	$2.78	430.12	5.84	$6.03	$8.81	35.04
First lead-arsenate or calyx	120	7.78	5.33	2.74	454.10	6.17	1.73	4.47	17.78
Second lead-arsenate	94	5.50	3.74	1.94	309.61	4.21	1.15	3.09	12.29
Third lead-arsenate	86	5.08	3.48	1.79	282.97	3.84	1.10	2.89	11.50
Fourth lead-arsenate	118	6.90	4.72	2.43	381.03	5.18	1.42	3.85	15.32
Fifth lead-arsenate	50	3.09	2.11	1.09	164.15	2.23	.65	1.74	6.92
Sixth lead-arsenate	10	.45	.34	.16	27.19	.37	.13	.29	1.15

MISCELLANEOUS LABOR.

A certain amount of labor done on the various ranches during the year is classified as miscellaneous labor. Among the more important items are overhauling the spray outfit, scraping and doctoring the trees, cutting blight, summer pruning, cleaning of lateral ditches, cutting water spouts, and hoeing about the trees. This miscellaneous labor charge on the 75 clean-cultivated orchards was 12.09 man-hours and 0.92 horse-hour, or $3.16 per acre and $0.0070 per packed box; while in orchards under mulch-crop management this charge was 7.21 man-hours and 0.52 horse-hour, or $1.88 per acre and $0.0047 per packed box.

Considering the 120 orchards, the annual miscellaneous labor charge was $2.68 per acre or $0.0062 per packed box.

TOTAL MAINTENANCE COST.

The total maintenance labor on 43 orchards under clean-cultural management in the North Yakima district was 208.14 man-hours and 97.67 horse-hours, while on the 32 orchards under similar management in the Zillah district the charge was 241.92 man-hours and 104.03 horse-hours.

In the case of the 21 orchards under mulch-crop management in the North Yakima district the charge was 197.45 man-hours and 76.23 horse-hours, while on the 24 orchards under similar management in the Zillah district the charge was 202.76 man-hours and 74.24 horse-hours.

The net labor cost up to harvest time was 34.82 per cent of the total net labor cost in the North Yakima district, while in the Zillah district it was 38.72 per cent.

The total maintenance charge per acre on the 75 orchards under clean cultivation was 222.55 man-hours and 100.38 horse-hours, while on the 45 orchards under mulch-crop management it was 200.29 man-hours and 75.18 horse-hours.

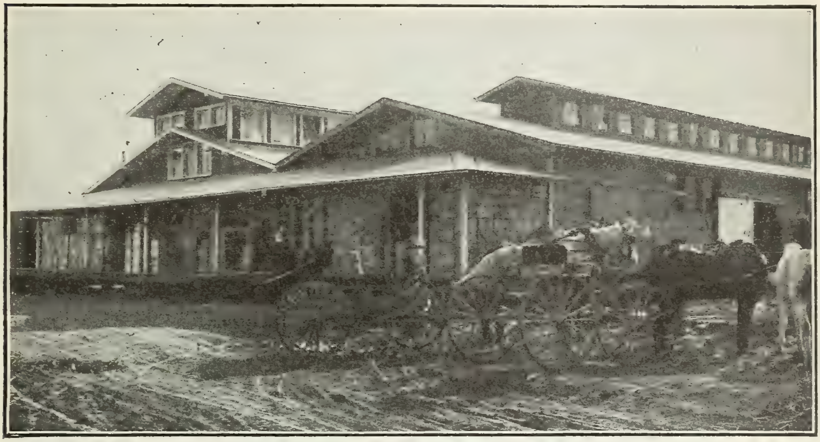

FIG. 8.—One of the larger packing sheds in the Yakima district.

Considering all records in the valley, the total net labor cost up to harvest time was $61.22 per acre, or $0.1417 per box. This is 41.08 per cent of the total net labor cost.

HANDLING THE CROP.

"Handling the crop" includes all the labor necessary to deliver it at a local association or shipping point. This labor includes the hauling of the box shook to the ranch, the making up of the box, hauling empty boxes to and full boxes from the orchard during harvesting and picking, and all packing-house labor, including sorting, packing, nailing, waiting, foreman, etc.

Twelve of the 64 orchardists visited in the North Yakima district hauled their picked apples to a local association, where they were sorted, graded, and packed at a stipulated price (see fig. 8), which included box, paper, nails, and labeling, or a complete packed box. This price ranged between $0.25 and $0.28 per packed box.

Where all records taken in the valley are considered, the total net labor cost per acre for handling was $87.79 or 25 per cent of the total annual net cost of production.

PICKING.

Picking is usually begun in the early part of September on a few early varieties, but the most intensive harvesting comes with Jonathan picking about the middle of September and continues well into November, or until the Winesaps are picked. The fruit on a tree is usually harvested with one picking. However, some orchardists make two or three pickings from the trees of the red varieties. In this way it is usually possible to get a crop of better color and size than with one picking.

All picking is done by hand. An 8- to 14-foot ladder and 18-quart picking pail or canvas bag constitute the picker's equipment. The bag is suspended directly in front of the picker by means of shoulder straps. The bottom of the bag is formed by a flap of the canvas which is held in place by a snap and ring. By unsnapping the ring the apples are allowed to roll out of the bottom of the bag into the box. The majority of growers use this type of picking sack.

TABLE XXXVII.—*Number of boxes picked in 10 hours and cost per box and per acre on the farms studied in Yakima Valley.*

District.	Clean-cultural management.				Mulch-crop management.			
	Loose boxes in 10 hours.	Cost per loose box.	Cost per packed box.	Cost per acre.	Loose boxes in 10 hours.	Cost per loose box.	Cost per packed box.	Cost per acre.
North Yakima	64.22	$0.0390	$0.0584	$27.74	66.60	$0.0376	$0.0563	$24.44
Zillah	55.71	.0449	.0673	28.33	59.81	.0418	.0627	23.01

District.	Combined management.			
	Loose boxes in 10 hours.	Cost per loose box.	Cost per packed box.	Cost per acre.
North Yakima	64.98	$0.0385	$0.0577	$26.66
Zillah	57.26	.0437	.0655	26.05

Practically all picking is done by man day labor, at the rate of from $0.225 to $0. 25 per hour. A few exceptions were reported where contract picking was done at from $0.035 to $0.04 per loose box, but none of the orchardists considered in this study hired their picking done in this way. Ordinarily a man will pick between 50 and 75 loose boxes in 10 hours, varying with the crop (yield per tree), the variety, the size, the age of tree, etc.

Table XXXVII gives the variations in the number of boxes that usually are picked in a day in the North Yakima and Zillah districts. After the apples are picked they are placed in boxes which previously have been distributed throughout the orchard at convenient places. The pickers fill the boxes without heaping, and thus one box may be piled upon another without injury to the fruit. Usually as the boxes are filled they are piled in the shade at a place conveniently located for hauling into the packing shed. In some instances "lug boxes" are used for hauling the picked fruit to the packing shed. This box is of a little heavier type than the ordinary packing box, a little wider and longer, and a little shallower, but has somewhat greater capacity than the picking box. These boxes are used mostly in some of the very large orchards. As a rule, however, orchardists considered in this investigation use the regular packing box.

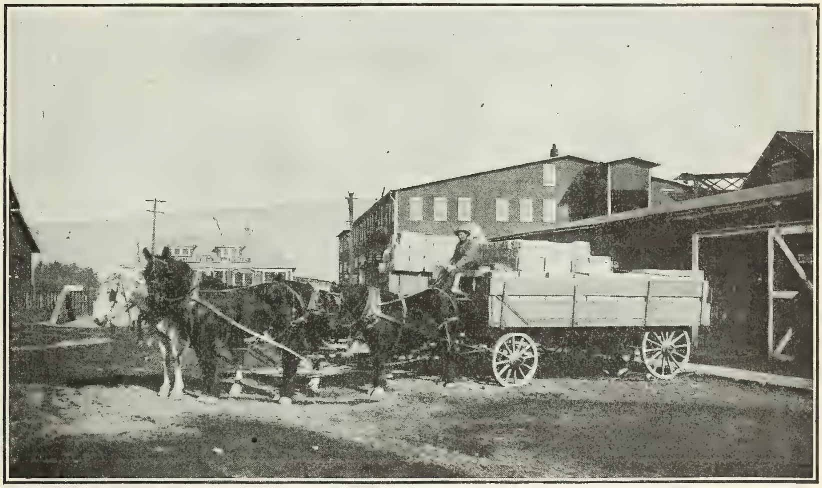

FIG. 9.—Hauling box shooks to the ranch. It is the practice to haul the box shooks from the station, and make up the boxes before harvesting time at the ranch.

The yield is the greatest limiting factor in determining the amount a picker can pick in a day, but where day labor is used the variation in the amount picked is not great, owing to the attempt on the part of the picker to pick about the same number of boxes per day and at about the same cost per box regardless of the crop. (See Table XXXVIII.)

The yields averaging 200 boxes or less were on the younger orchards. Usually the apples on young trees are well placed and of good size, the trees are smaller, and there is not so much need of a ladder, so that, if the fruit is not scattered too widely, the picker often will be able to pick more in a given time than where the crop is larger though on bigger trees.

If contract labor had been employed for picking, no doubt up to a certain point the effect of the yield on the picking time would have been more noticeable; for, no matter how large a crop may be, there is a limit to the amount of fruit the average picker is able to pick.

On the farms studied in the North Yakima district 106.62 hours were required to pick an acre yielding an average of 462 packed boxes, at a cost of $26.66, or $0.0577 per packed box; while in the Zillah district, with an average yield of 398 packed boxes per acre 104.21 hours were required, at a cost of $26.05, or $0.0655 per packed box.

In the valley as a whole, all records considered, the total charge per acre for picking, with an average yield of 432 packed boxes, was 105.50 man-hours, or $26.38, or $0.0611 per packed box.

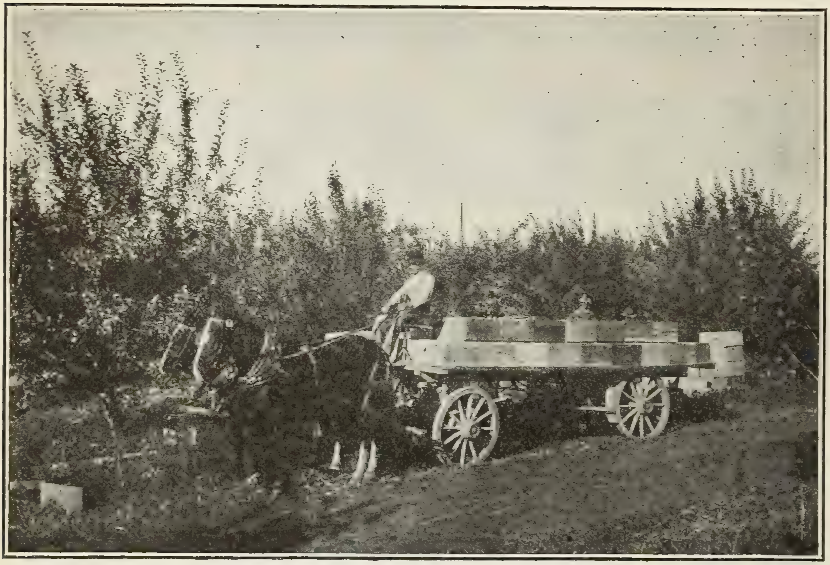

Fig. 10.—Hauling the filled loose boxes from the orchard to the packing shed. Trucks are used on long hauls.

The cost of picking in the valley is 30.05 per cent of the total net handling cost, or 17.70 per cent of the total net annual labor cost, or 7.63 per cent of the total net annual cost of production.

Table XXXVIII.—*Influence of yield on picking time and cost on 120 farms in the Yakima Valley.*

Yield per acre in packed boxes.	Number of orchards.	Packed box yield per acre.	Loose boxes in 10 hours.	Cost per acre.	Cost per tree.	Cost per packed box.	Cost per loose box.
200 and under	10	164.64	66.60	$9.27	$0.14	$0.0563	$0.0375
201 to 300	18	241.49	56.57	16.02	.23	.0663	.0442
301 to 400	31	346.33	60.00	21.66	.31	.0625	.0417
401 to 500	26	448.25	63.14	26.64	.37	.0594	.0396
501 to 600	13	544.28	64.65	31.56	.38	.0580	.0387
Over 600	22	744.08	60.78	45.89	.55	.0617	.0411
All records	120	432.00	61.38	26.38	.39	.0611	.0407

HAULING BOX SHOOKS.

All growers considered in this discussion hauled box shooks to their ranches. Short hauls are made possible by spurs or sidings provided by the railways. Usually one man and two horses are used for hauling shooks. Sometimes four horses are used. (See fig. 9.) Ten orchardists, however, used one man and one horse and five used two men and two horses when hauling shooks. In the North Yakima district a crew of one man and two horses hauled an average load of 529 box shooks an average of 2.46 miles at a cost of $0.0041 per shook, or $0.0017 per shook per mile; while in the Zillah district a similar crew hauled an average load of 412 shooks an average of 1.20 miles, at a cost of $0.0032 per shook, or $0. 0027 per shook per mile. Considering all records in the valley, whatever the size of crew, the average distance hauled was 1.81 miles, with an average cost per shook of $0.0038 or $0.0021 per shook per mile.

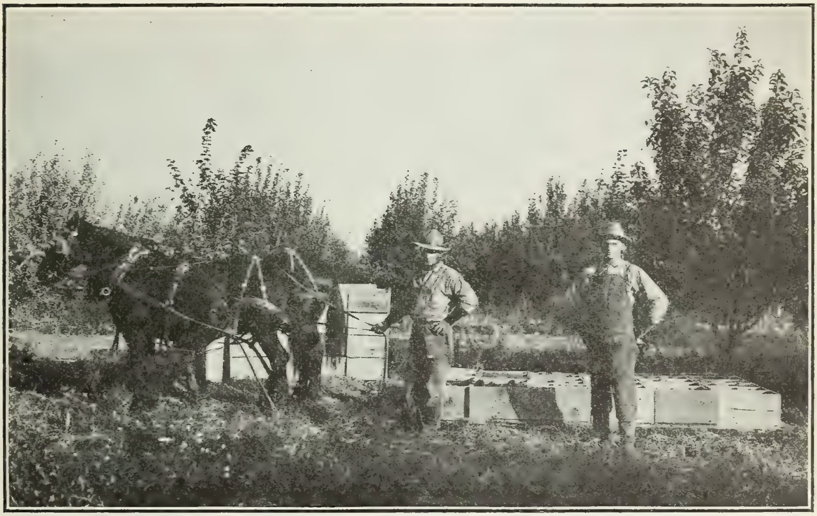

FIG. 11.—Hauling the filled loose boxes from the orchard to packing shed by means of a slip boat. Slip boats or sleds are used on short hauls.

MAKING BOXES.

As in other Northwestern apple-producing areas, most of the boxes are made up on the ranch at odd times before picking time or during the early part of harvesting. Much of this work is done by contract labor at $0.0065 to $0.01 per box. On many of the small ranches the boxes are made by the owner or members of his family. A man will make from 200 to 500 boxes per day, depending upon his expertness. In this study the charge is $0.0065 for making a box.

ORCHARD HAULING.

In the larger orchards one man is employed exclusively in orchard hauling. In the smaller orchards it is not necessary for one man to be constantly employed in hauling to and from the orchard. As a rule, the owner does the orchard hauling and either superintends the pickers or assists in the packing house when not employed in hauling. In general the orchardists here consider the hauling to and from the orchard as separate operations, and they have so been considered in this study. The majority of orchardists use a low truck wagon with one man and a team for hauling. (See fig. 10.) A few in the smaller orchards use a sled with either one man and two horses or one man and one horse. (See fig. 11.) Practically the same methods are practiced in both districts.

On the farms studied in the North Yakima district 33 orchardists used a wagon for orchard hauling, 22 had a crew of one man and two horses, and 11 had one man and one horse. Thirteen used a sled, 6 with a crew of one man and two horses and 7 with one man and one horse. There were 18 orchardists whose time of hauling to and from the orchard was lumped as one item.

On the farms studied in the Zillah district 36 orchardists used a wagon for hauling, with a crew of one man and two horses; 9 used a sled, 8 with a crew of one man and two horses and one with one man and one horse; and 4 used a wagon with two men and two horses. There were 7 whose time of hauling to and from the orchard was lumped as one item.

TABLE XXXIX.—*Comparative cost of hauling boxes to and from the orchard on a wagon or a sled when both operations are done with a crew of one man and two horses (62 farms, Yakima Valley).*

Vehicle.	Records.	Empty boxes to orchard.			Full boxes from orchard.			Total cost per loose box.	Total cost per packed box.
		Boxes per load.	Cost per loose box.	Cost per packed box.	Boxes per load.	Cost per loose box.	Cost per packed box.		
Wagon	50	91	$0.0040	$0.0061	40	$0.0093	$0.0139	$0.0133	$0.0200
Sled	12	60	.0056	.0084	20	.0119	.0179	.0175	.0263

Table XXXIX gives the average number of boxes, empty and full, hauled on a wagon or sled by a crew of one man and two horses. The total cost of hauling is somewhat larger where a sled is used. The actual average cost of 95 orchardists for hauling to the orchard, regardless of crew or method employed, was $0.0045 per empty box, or $0.0068 per packed box. Twelve of this number hauled their apples directly to a central packing house, while the average actual cost for the remaining 83 for hauling loose boxes to the packing shed on the ranch, regardless of crew or method employed, was $0.0045 per loose box or $0.0068 per packed box.

There were 25 orchards in which one man was constantly employed in hauling boxes to and from the orchard. The average cost for this operation was $0.0124 per loose box, or $0.0186 per packed box. One hundred and eight orchardists make a practice of hauling empty boxes to the orchard and full boxes to the packing house on the ranch, at a cost of $0.0216 per packed box. The orchard hauling charge, considering the 120 orchards, whatever the size of crew or method employed, was $0.0205 per packed box. (See Table XLII.)

PACKING-HOUSE LABOR.

Packing-house labor includes sorting, packing, nailing, waiting on the packers or sorters, foremen services, and any other packing-house labor, such as the service of truckers or men employed to handle the boxes about the packing house. (See fig. 12.) Ordinarily extra help is employed only where a large packing crew is used, the members of the family usually making up the crew.

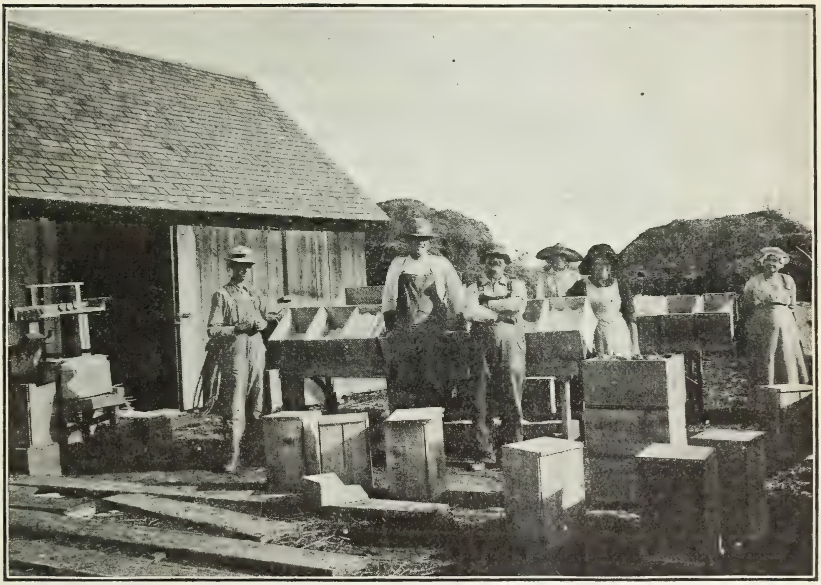

FIG. 12.—A packing crew on a small ranch in the Yakima district. Most men pack all their fruit inside the packing house.

The packing-house-labor cost for the 64 farms about North Yakima was $45.47 per acre, or $0.0984 per box, and $45.64 per acre, or $0.1147 per box, for the 56 farms about Zillah or the lower Yakima Valley. If the 120 farms studied are considered, the average cost was $45.55 per acre, or $0.1054 per box, or 30.57 per cent of the total net maintenance and handling costs. (See Table XL.)

SORTING.

The time required for sorting depends much on the variety and condition of the fruit and whether or not mechanical sizers or wipers are used. The number employed in the sorting crew depends upon the size of the crop and the method of handling. Where there are enough apples to make the use of a mechanical sizer economical, from two to six sorters usually are employed about the sorting table of the sizer. Men who do not use a sizer usually employ hands to sort the fruit for the packers from picking boxes or tables. In some cases packers sort their own apples. In most instances more sorters than packers are employed. Some growers find it necessary to use two sorters to one packer, while a few claim that one sorter will take care of two packers. A very common crew is three packers, four sorters, and one man to nail and wait on the packers and sorters. Most of the fruit in the valley is sorted and packed into three grades—"Extra Fancy," "Fancy," and "C. Grade." At the time of this study the majority of growers sorted their fruit by hand.

It was found that the average number of boxes sorted by one man in a day was 73 at North Yakima and 52 at Zillah. This difference is due largely to the fact that there is often more codling-moth injury in the Zillah district.

TABLE XL.—*Packing-house-labor costs (120 records, Yakima Valley).*

Operation.	North Yakima district (64 records.)			Zillah district (56 records).			Yakima Valley (120 records).		
	Number of records.	Cost.		Number of records.	Cost.		Number of records.	Cost.	
		Per acre.	Packed box.		Per acre.	Packed box.		Per acre.	Packed box.
Sorting	41	$16.16	$0.0341	53	$19.55	$0.0480	94	$18.07	$0.0414
Packing	45	23.82	.05	55	19.94	.05	100	21.68	.05
Sorting and packing	7	33.08	.06	1	21.00	.06	8	31.57	.06
Nailing	19	4.61	.0091	20	3.50	.0089	39	4.04	.0090
Waiting	3	5.86	.0097	8	3.29	.0084	11	3.99	.0088
Nailing and waiting	31	6.22	.0132	33	4.34	.0105	64	5.25	.0119
Foreman	6	7.22	.0132	17	4.13	.0082	23	4.94	.0096
Other packing labor	5	17.69	.0409	18	5.12	.0121	23	7.85	.0185
Packing-house labor	52	46.07	.0948	56	45.64	.1147	108	45.84	.1039
Warehouse packing	12	42.81	.1209				12	42.81	.1209
Total packing-house-labor charge [1]	64	45.47	.0984	56	45.64	.1147	120	45.55	.1054

[1] Fifty-two orchardists handle their fruit on their own ranches, 12 handle it through an association; the 64 records combine both methods.

If all records are considered, it is found that the average sorter will sort 60 boxes in 10 hours. This refers to packed boxes, which in terms of loose boxes would be practically 90. The average cost of sorting for the 94 orchardists of the 120 studied who sort their own apples or have them sorted on the farm is $18.07 an acre, or $0.0414 per box. (See Table XL.)

Where a wiping machine is used, which in the case of these records is only in the Zillah district, the sorting cost is less than that where no such machine is used. At one end of the wiping machine the apples are fed into an endless carrier by one or more men. On either side of the carrier is a rotating cylinder covered with strips of cloth, which serve to wipe the fruit clean from spray material or dust before it reaches the sorters. It is claimed that the wiping greatly aids the sorter, enabling him readily to detect worm stings or marks. In addition to this the machine if properly handled will assure the steady flow of apples to the sorters.

Many orchardists claim that this machine is practical only where the crop is at least 2,000 boxes, although it would seem that its use would be practical for a smaller crop.

Where mechanical sizers are used, sorting is usually more rapid, for the apples are placed on a sorting table, which enables the sorters to work more rapidly and more conveniently. In such cases there is always one man to wait on the sorters or dump the apples on the sorting table. Mechanical sizers are coming into more general use.

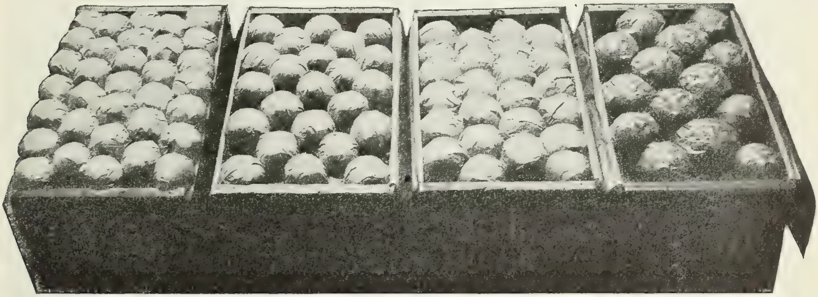

FIG. 13.—Four kinds of packs used in packing box apples. The size of apple usually determines the pack.

PACKING.

On 100 of the 120 farms considered in this survey the growers packed their own apples. Forty-five of these men are located about North Yakima and 55 in Zillah, or the lower valley district. Packers are usually paid by the box, at from $0.03 to $0.05 per box. Both men and women are employed as packers. An average day's work for the valley was 72 packed boxes. In addition to the 100 men who pack, there are 8 who sort and pack. This is slower work when done by the piece. The pay is from $0.01 to $0.02 more per box than for merely packing. The seven orchardists in North Yakima who sort and pack 59 boxes in 10 hours, at the rate of 6 cents per packed box, give a fair average for the valley.

The diagonal pack is used (see fig. 13) and apples are sized by the packer, unless a mechanical sizer is used, in which case the rate paid per box is less, usually $0.03 to $0.04.

The packing cost per box on 100 farms studied was $0.05, or $21.68 per acre.

NAILING AND WAITING.

Many of the orchardists in both regions employ one man to nail the packed boxes and wait on the packers or sorters. The cost of nailing and waiting was $0.0132 per box for the North Yakima ranches and $0.0105 for those of Zillah, or an average of $0.0119 per box for both districts, 64 records being considered.

Other orchardists employ a man to do nothing but nail and stamp the boxes. It was found that a nailer when doing no other labor would nail 275 boxes per day on the North Yakima ranches and 281 on the Zillah ranches, or 278 when both districts were considered, while 210 boxes is the average day's work for nailing and waiting. Eleven of the men employed waiters who did nothing but wait on the packers and sorters, each handling about 284 boxes per day.

FOREMAN.

In most instances, on account of the small size of the orchards in these regions, it is not found necessary to employ a foreman. On the ranches studied there were but 6 men in the North Yakima district and 17 in the Zillah district who employed foremen in the packing houses. In most other cases the owner himself acted as foreman, at the same time doing some other labor in the packing house, usually nailing. On the ranches studied, where a foreman was employed the foreman cost per box was $0.0096, or practically $0.01 per box.

OTHER PACKING-HOUSE LABOR.

The other packing-house labor, which includes truckers, or men employed about the packing house to handle the fruit in some way other than those already mentioned, amounts to $0.0185 per box for the 23 men who employ other packing-house labor, or, if this is prorated over all records, $0.0035 per box.

ALL PACKING-HOUSE LABOR COSTS.

The total of all packing-house labor for the 108 men who did their own sorting and packing was $0.1039 per box, while in the case of the 12 men who hauled to an association warehouse and had the fruit packed it was $0.1209 per box, or for the total 120 records, $45.55 per acre, and $0.1054 per box, or 30.57 per cent of the total net maintanance and handling cost.

CULL APPLES.

Cull or cider apples which have been gathered from the ground or culled in the packing shed (see fig. 14) are often hauled to a cider mill in the vicinity of North Yakima. In the Zillah district there was no by-product plant at the time this study was made. A few of the growers hauled their cull apples in boxes to the town of Zillah and shipped them to some town in which such a plant was located. The load is usually from 1 to 1½ tons.

One cider mill located in the vicinity of North Yakima might be termed a cooperative factory. A number of growers in the vicinity of North Yakima have put $100 each into this enterprise, and have the privilege of selling all their cull apples to the factory. If the mill is not kept busy by the apples of these stockholders, growers outside of the company have the privilege of delivering their cull apples at the same price received by the stockholders.

It is not the general practice of the growers of the valley, however, to pick up the apples in the orchard or sell their cull apples to a by-product plant. At the time of this investigation many of the growers on the farms studied did not believe the labor expended would be warranted by the price which they received for their cider apples. In many instances apples are picked up and used for live-stock feed or often the live-stock is pastured in the orchard for a time. Various estimates on the value of cull apples for feed were made by the orchardists under consideration. In each instance the orchard has been given the estimated credit for the feed value as given by the individual orchardist.

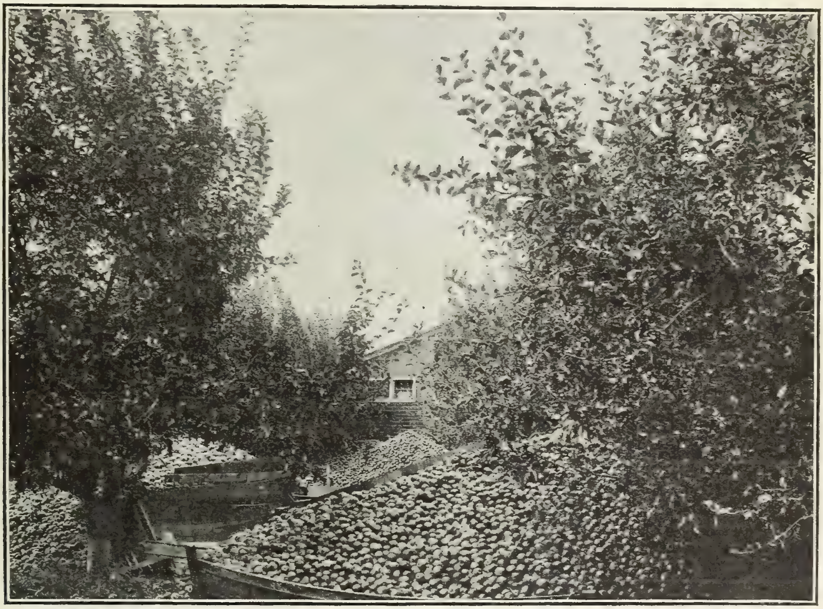

FIG. 14.—Culls outside of a large packing house. These culls are frequently a total waste. Sometimes they are made into cider or vinegar.

The usual price paid by the cider mill for cull apples during the past few years has been $4.50 per ton. The average net credit of the 57 orchardists who handled their cull apples was $3.68 per acre. Considering all records of the valley, the prorate credit was $2.25 per acre, or $0.0052 per box.

HAULING PACKED BOXES.

Boxes usually are hauled to the local association or station as soon as possible after the fruit is packed. The majority of growers use a wagon or truck with a crew of one man and two horses for hauling. Six growers used a crew of one man and one horse, one a crew of two men and two horses, and one a crew of three men and two horses. Nine orchardists in the North Yakima district hired their hauling done at a cost of from $0.015 to $0.025 per box, varying with the distance from the station. Seventy-seven per cent of the men in the North Yakima district and 96 per cent in the Zillah district used a crew of one man and two horses for hauling packed boxes to the station. Table XLI gives the comparative cost of hauling with a crew of one man and two horses in each district. The load varies from 50 to 120 boxes. For the entire valley the average cost for hauling packed boxes to the station with a crew of one man and two horses was $0.0150 per packed box, or $0.0085 per box per mile.

Considering the 120 records taken in the valley, regardless of whether the apples were hauled by the owners or by contract to a station or an association, the cost was $0.0165 per box, or $0.0089 per box per mile. The average distance hauled was 1.85 miles and the average load 81 boxes. (See Table XLII.)

TABLE XLI.—*Time and cost for hauling packed boxes to the station where a crew of one man and two horses is used.*

District.	Number of records.	Per acre.			Cost per box.	Average distance hauled.	Cost per box per mile.	Average load.	Yield per acre.
		Man-hours.	Horse-hours.	Cost.					
North Yakima	42	15.41	30.82	$8.47	$0.0169	2.49	$0.0068	96	501
Zillah	54	9.49	18.98	5.22	.0131	1.18	.0111	86	398
North Yakima and Zillah	96	12.08	24.16	6.64	.0150	1.75	.0085	90	443

The cost of all hauling, including the hauling of the shooks to the ranch, the orchard hauling, hauling full boxes to a central packing house, and hauling the packed box to the station, was 4.91 per cent of the total net cost of production on the ranches studied in the North Yakima district, and 5.37 per cent on those studied in the Zillah district. The total cost of all hauling for the records considered in the valley was 5.10 per cent of the total net cost of production, or $0.0408 per packed box.

TABLE XLII.—*Cost of all hauling on 120 farms studied.*

Operation.	Number of records.	Yield.	Load.	Miles.	Cost per acre.	Cost per packed box.	Cost per box per mile.
Hauling shooks	120	432	462	1.81	$1.66	$0.0038	$0.0021
Hauling boxes to and from orchard[1]	120	432	54	....	8.84	.0205	....
Hauling packed boxes to station (108)	120	432	81	1.85	7.12	.0165	.0089
Hauling loose boxes to association (12)							

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[1] Twelve orchardists hauled empty boxes to the orchard, but hauled their full boxes to a central packing shed.

TOTAL HANDLING COST.

The total net handling cost of the North Yakima district (64 orchards considered) was $89.26 per acre, or $0.1932 per box, while in the Zillah district (56 orchards considered) the acre cost was $86.12, or $0.2164 per box. The labor cost, with no credit for culls, was $0.0232 more per box in the Zillah district.

Considering all orchards studied, there appears to be little difference in the total net handling costs per box between the orchards under clean-cultural and those under mulch-crop management. On the former it is 56.97 per cent, the latter 63.12 per cent of the total net labor cost.

The total net handling cost for the 120 orchards studied was $87.79 per acre, or $0.2032 per box. This cost is 58.92 per cent of the total net labor, or 25.40 per cent of the total net cost of production.

TOTAL LABOR COST.

When the total labor cost for the 120 farms studied in the Yakima Valley is considered, there is found to be a net labor cost per acre of $149.01, or $0.3449 per box, after credit has been allowed for hay or pasture, wood for fuel, and all fruit not packed in boxes. This total credit amounts to $0.0190 per box. The net maintenance cost amounts to $0.1417 per box, or 41.09 per cent of the total net labor cost, while the net labor cost for handling amounts to $0.2032 per box, or 58.92 per cent of the total net labor cost. As will be seen from Table XLIII, the total net handling cost per box is practically the same under both the clean-cultural and the mulch-crop system, but the net labor cost per box for maintenance labor is much less in the case of the mulch-crop system. There is a net maintenance cost of $70.03 per acre in the case of the 75 clean-cultural orchards and $46.49 in the case of the mulch-crop orchards. If no credit is given the mulch-crop orchards, there is still a difference of $9.35 per acre in their favor. The cost per box, if no credit is given, is practically the same for the two systems, as the yield is 54 boxes per acre greater in the case of the clean-cultural orchards.

TABLE XLIII.—*Summary of all labor costs for Yakima Valley (120 records).*

Items.	Clean-cultural management (75 records; 452 boxes).				Mulch-crop management (45 records; 398 boxes).				Combined management (120 records; 432 boxes).			
	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manuring	$4.00	$0.0088	2.46	1.10	$3.46	$0.0087	2.74	1.09	$3.80	$0.0088	2.55	1.10
Pruning	13.42	.0297	8.24	3.69	12.66	.0318	10.04	4.01	13.14	.0304	8.82	3.80
Disposal of brush	4.59	.0102	2.82	1.26	4.53	.0114	3.59	1.43	4.57	.0106	3.06	1.32
Plowing	1.50	.0033	.92	.41	.65	.0016	.52	.20	1.18	.0027	.79	.34
Other cultivating	11.26	.0249	6.92	3.10	3.72	.0093	2.95	1.18	8.43	.0195	5.66	2.44
Irrigating	4.63	.0102	2.84	1.27	3.97	.0100	3.15	1.26	4.38	.0102	2.94	1.27
Thinning	13.08	.0289	8.04	3.60	11.13	.0280	8.83	3.52	12.35	.0286	8.29	3.57
Propping	1.67	.0037	1.03	.46	1.40	.0035	1.11	.44	1.57	.0036	1.05	.45
Miscellaneous	3.16	.0070	1.94	.87	1.88	.0047	1.49	.60	2.68	.0062	1.80	.78
Lime-sulphur spray	2.78	.0062	1.71	.77	2.77	.0070	2.20	.88	2.78	.0065	1.86	.81
Lead-arsenate spray	10.60	.0235	6.51	2.92	9.41	.0236	7.47	2.98	10.16	.0235	6.82	2.94
Sowing mulch crop					.03	.0001	.02	.01	.01		.01	
Harvesting mulch crop					5.73	.0144	4.55	1.81	2.15	.0050	1.44	.62
Total maintenance cost	70.69	.1564	43.43	19.45	61.34	.1541	48.66	19.41	67.20	.1556	45.09	19.44
Hay or pasture credit					14.26	.0358	11.31	4.51	5.35	.0123	3.59	1.55
Wood credit	.66	.0015	.40	.18	.59	.0015	.47	.19	.63	.0015	.42	.18
Total credit	.66	.0015	.40	.18	14.85	.0373	11.78	4.70	5.98	.0138	4.01	1.73
Total net maintenance cost	70.03	.1549	43.03	19.27	46.49	.1168	36.88	14.71	61.22	.1417	41.08	17.71
Hauling shooks	1.72	.0038	1.05	.47	1.55	.0039	1.23	.49	1.66	.0038	1.12	.48
Hauling boxes to and from orchard	9.65	.0214	5.93	2.66	7.49	.0188	5.94	2.37	8.84	.0205	5.93	2.56
Picking	27.99	.0620	17.20	7.70	23.68	.0595	18.78	7.49	26.38	.0611	17.70	7.63
Packing-house labor	47.65	.1054	29.28	13.11	42.04	.1056	33.35	13.31	45.55	.1054	30.57	13.18
Hauling to station or association	7.20	.0159	4.42	1.98	6.98	.0176	5.54	2.21	7.12	.0165	4.78	2.06
Picking up and hauling culls	.55	.0012	.34	.15	.41	.0010	.33	.13	.49	.0011	.33	.14
Total handling cost	94.76	.2097	58.22	26.07	82.15	.2064	65.17	26.00	90.04	.2084	60.43	26.05
Cull credit	2.04	.0045	1.25	.56	2.59	.0065	2.05	.82	2.25	.0052	1.51	.65
Total net handling cost	92.72	.2052	56.97	25.51	79.56	.1999	63.12	25.18	87.79	.2032	58.92	25.40
Total net labor cost	162.75	.3601	100.00	44.78	126.05	.3167	100.00	39.89	149.01	.3449	100.00	43.11

TABLE XLIV.—*Summary of all labor costs for North Yakima district (64 records).*

Items.	Clean-cultural management (43 records; 475 boxes).				Mulch-crop management (21 records; 434 boxes).				Combined management (64 records; 462 boxes).			
	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manuring	$3.16	$0.0067	1.99	0.80	$3.28	$0.0075	2.58	0.87	$3.20	$0.0069	2.15	0.82
Pruning	14.04	.0295	8.83	3.55	13.60	.0313	10.71	3.62	13.90	.0301	9.36	3.57
Disposal of brush	4.51	.0095	2.84	1.14	4.30	.0099	3.38	1.14	4.44	.0096	2.99	1.14
Plowing	1.62	.0034	1.02	.41	.86	.0020	.68	.23	1.37	.0031	.92	.35
Other cultivating	12.26	.0258	7.70	3.09	3.82	.0088	3.01	1.02	9.49	.0205	6.39	2.44
Irrigating	5.08	.0107	3.19	1.28	4.43	.0102	3.49	1.18	4.86	.0105	3.27	1.25
Thinning	9.34	.0197	5.87	2.36	8.13	.0187	6.40	2.16	8.94	.0194	6.02	2.29
Propping	2.02	.0043	1.27	.51	1.81	.0042	1.43	.48	1.95	.0042	1.31	.50
Miscellaneous	3.06	.0064	1.92	.77	1.85	.0043	1.46	.49	2.67	.0058	1.80	.69
Lime-sulphur spray	2.66	.0056	1.67	.67	2.63	.0061	2.07	.70	2.65	.0057	1.78	.68
Lead-arsenate spray	8.94	.0188	5.62	2.26	7.95	.0183	6.26	2.11	8.61	.0186	5.80	2.21
Sowing mulch crop					.03	.0001	.02	.01	.01		.01	
Harvesting mulch crop					8.11	.0187	6.39	2.16	2.66	.0058	1.79	.68
Total maintenance cost	66.69	.1404	41.92	16.84	60.80	.1401	47.88	16.17	64.75	.1402	43.59	16.62
Hay or pasture credit					16.58	.0382	13.06	4.41	5.44	.0118	3.66	1.40
Wood credit	.02		.01	.01					.01		.01	
Total credit	.02		.01	.01	16.58	.0382	13.06	4.41	5.45	.0118	3.67	1.40
Total net maintenance cost	66.67	.1404	41.91	16.83	44.22	.1019	34.82	11.76	59.30	.1284	39.92	15.22
Hauling shooks	2.10	.0044	1.32	.53	1.85	.0042	1.46	.49	2.02	.0044	1.36	.52
Hauling boxes to and from orchard	8.96	.0189	5.63	2.26	7.11	.0164	5.60	1.89	8.35	.0181	5.62	2.14
Picking	27.74	.0584	17.44	7.00	24.44	.0563	19.24	6.50	26.66	.0577	17.94	6.84
Packing-house labor	46.43	.0977	29.19	11.72	43.48	.1002	34.24	11.56	45.47	.0984	30.61	11.67
Hauling to station or association	8.86	.0186	5.57	2.24	8.60	.0198	6.77	2.29	8.78	.0190	5.91	2.25
Picking up and hauling culls	.80	.0017	.50	.20	.80	.0019	.63	.21	.80	.0017	.54	.21
Total handling cost	94.89	.1997	59.65	23.95	86.28	.1988	67.94	22.94	92.08	.1993	61.98	23.63
Cull credit	2.48	.0052	1.56	.62	3.51	.0081	2.76	.93	2.82	.0061	1.90	.72
Total net handling cost	92.41	.1945	58.09	23.33	82.77	.1907	65.18	22.01	89.26	.1932	60.08	22.91
Total net labor cost	159.08	.3349	100.00	40.16	126.99	.2926	100.00	33.77	148.56	.3216	100.00	38.13

TABLE XLV.—*Summary of all labor costs for the Zillah district (56 records).*

Items.	Clean-cultural management (32 records; 421 boxes).				Mulch-crop management (24 records; 367 boxes).				Combined management (56 records; 398 boxes).			
	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.	Cost.		Per cent of total net labor cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manuring	$5.13	$0.0122	3.06	1.61	$3.63	$0.0099	2.90	1.38	$4.48	$0.0113	3.00	1.52
Pruning	12.59	.0299	7.51	3.94	11.85	.0323	9.46	4.50	12.27	.0308	8.21	4.15
Disposal of brush	4.70	.0112	2.80	1.47	4.73	.0129	3.78	1.80	4.71	.0119	3.15	1.59
Plowing	1.35	.0032	.80	.42	.46	.0013	.37	.17	.97	.0024	.65	.33
Other cultivating	9.92	.0236	5.92	3.10	3.63	.0099	2.90	1.38	7.23	.0182	4.83	2.45
Irrigating	4.02	.0095	2.40	1.26	3.57	.0097	2.85	1.36	3.83	.0096	2.56	1.30
Thinning	18.11	.0430	10.80	5.67	13.76	.0375	10.99	5.22	16.25	.0408	10.87	5.50
Propping	1.20	.0029	.72	.38	1.04	.0028	.83	.39	1.13	.0028	.76	.38
Miscellaneous	3.29	.0078	1.96	1.03	1.90	.0052	1.52	.72	2.70	.0068	1.80	.91
Lime-sulphur spray	2.94	.0070	1.75	.92	2.90	.0079	2.31	1.10	2.92	.0073	1.95	.99
Lead-arsenate spray	12.85	.0305	7.66	4.02	10.69	.0291	8.53	4.06	11.92	.0300	7.97	4.03
Sowing mulch crop					.03	.0001	.02	.01	.01		.01	
Harvesting mulch crop					3.64	.0099	2.91	1.38	1.56	.0039	1.04	.53
Total maintenance cost	76.10	.1808	45.38	23.82	61.83	.1685	49.37	23.47	69.98	.1758	46.80	23.68
Hay or pasture credit					12.23	.0334	9.76	4.64	5.24	.0131	3.50	1.77
Wood credit	1.52	.0036	.91	.48	1.11	.0030	.89	.42	1.34	.0034	.90	.45
Total credit	1.52	.0036	.91	.48	13.34	.0364	10.65	5.06	6.58	.0165	4.40	2.22
Total net maintenance cost	74.58	.1772	44.47	23.34	48.49	.1321	38.72	18.41	63.40	.1593	42.40	21.46
Hauling shooks	1.22	.0029	.73	.38	1.28	.0035	1.02	.49	1.25	.0031	.84	.42
Hauling boxes to and from orchard	10.57	.0251	6.30	3.31	7.84	.0214	6.26	2.98	9.40	.0236	6.29	3.18
Picking	28.33	.0672	16.89	8.87	23.01	.0627	18.37	8.73	26.05	.0655	17.42	8.82
Packing-house labor	49.30	.1171	29.39	15.43	40.77	.1111	32.55	15.47	45.64	.1147	30.52	15.44
Hauling to station	4.97	.0118	2.96	1.56	5.55	.0151	4.43	2.11	5.22	.0131	3.49	1.77
Picking up and hauling culls	.20	.0005	.12	.06	.09	.0002	.07	.03	.15	.0004	.10	.05
Total handling cost	94.59	.2246	56.39	29.61	78.54	.2140	62.70	29.81	87.71	.2204	58.66	29.68
Cull credit	1.45	.0034	.86	.45	1.78	.0048	1.42	.68	1.59	.0040	1.06	.54
Total net handling cost	93.14	.2212	55.53	29.16	76.76	.2092	61.28	29.13	86.12	.2164	57.60	29.14
Total net labor cost	167.72	.3984	100.00	52.50	125.25	.3413	100.00	47.54	149.52	.3757	100.00	50.60

Tables XLIV and XLV give the labor costs for North Yakima and Zillah separately. As will be seen, the net cost per acre for all labor for North Yakima is $148.56, or $0.3216 per box, making 38.13 per cent of the total of all net costs, and in the case of Zillah $149.52 per acre, or $0.3757 per box, making 50.60 per cent of the total of all net costs. The net labor costs for Zillah constitute a much greater proportion of the total annual net cost than do the net labor costs of the North Yakima district.

EXPENSES OTHER THAN LABOR.

The expenses other than labor consist of material and fixed costs, The material costs include manure, all spray materials, seed, gasoline, oil, made-up boxes, paper, nails, etc. The fixed costs include interest on apple orchard, the apple-building charge, equipment, depreciation and upkeep, hired equipment, land taxes, water rent, and insurance.

The material costs for the North Yakima ranches made up 21.59 per cent of the total net annual cost. The fixed costs made up 40.28 per cent of the total net annual cost. Thus the material and fixed costs for North Yakima made up 61.87 per cent of the total net annual cost. (See Table XLVI.)

The material costs for the Zillah ranches made up 27.62 per cent of the total net annual cost, while the fixed costs made up 21.78 per cent of the total net annual cost. Material and fixed expenses made up 49.40 per cent of the total net annual cost. (See Table XLVII.)

In the case of all records for the Yakima Valley, including the North Yakima and Zillah districts, the material cost made up 42.17 per cent of the expense other than labor, while the fixed cost made up 57.83 per cent. Together they made up 56.89 per cent of the total annual net cost of production. (See Table XLVIII.)

TABLE XLVI.—*Summary of material and fixed costs for North Yakima district (64 records).*

Material and fixed costs.	Clean-cultural management (43 records; 475 boxes).				Mulch-crop management (21 records; 434 boxes).				Combined management (64 records; 462 boxes).			
	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manure	$6.03	$0.0127	2.55	1.52	$5.07	$0.0117	2.03	1.35	$5.72	$0.0124	2.37	1.47
Lime and sulphur	5.66	.0119	2.39	1.43	6.18	.0142	2.48	1.64	5.83	.0126	2.42	1.50
Lead arsenate (first spray)	1.43	.0030	.60	.36	1.66	.0038	.67	.44	1.50	.0032	.62	.38
Other spray material	3.16	.0067	1.33	.80	3.33	.0077	1.34	.89	3.22	.0070	1.34	.83
Seed					.43	.0010	.17	.11	.14	.0003	.06	.03
Gasoline and oil	.63	.0013	.27	.16	.52	.0012	.21	.14	.59	.0013	.24	.15
Made-up box	69.02	.1453	29.11	17.42	63.06	.1453	25.32	16.77	67.13	.1453	27.85	17.23
Total material cost	85.93	.1809	36.25	21.69	80.25	.1849	32.22	21.34	84.13	.1821	34.90	21.59
Interest	117.58	.2475	49.59	29.68	132.57	.3055	53.23	35.25	122.50	.2652	50.81	31.44
Apple-building charge	4.75	.0100	2.00	1.20	4.34	.0100	1.74	1.15	4.62	.0100	1.92	1.18
Equipment charge	8.72	.0184	3.68	2.20	9.78	.0225	3.93	2.60	9.07	.0196	3.76	2.33
Sprayer hire	2.01	.0042	.85	.51	1.79	.0041	.72	.48	1.94	.0042	.80	.50
Taxes	14.39	.0303	6.07	3.63	15.04	.0347	6.04	4.00	14.60	.0316	6.06	3.75
Insurance	1.04	.0022	.44	.26	1.27	.0029	.51	.34	1.12	.0024	.46	.29
Water rent	2.66	.0056	1.12	.67	4.01	.0092	1.61	1.07	3.10	.0067	1.29	.79
Total fixed cost	151.15	.3182	63.75	38.15	168.80	.3889	67.78	44.89	156.95	.3397	65.10	40.28
Total material and fixed costs	237.08	.4991	100.00	59.84	249.05	.5738	100.00	66.23	241.08	.5218	100.00	61.87

TABLE XLVII.—*Summary of material and fixed costs for Zillah district (56 records).*

Material and fixed costs.	Clean-cultural management (32 records; 421 boxes).				Mulch-crop management (24 records; 367 boxes).				Combined management (56 records; 398 boxes).			
	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manure	$10.21	$0.0243	6.73	3.20	$6.17	$0.0168	4.46	2.34	$8.48	$0.0213	5.81	2.87
Lime and sulphur	6.40	.0152	4.22	2.00	6.09	.0166	4.41	2.31	6.27	.0157	4.30	2.12
Lead arsenate (first spray)	2.01	.0048	1.32	.63	1.94	.0053	1.40	.74	1.98	.0050	1.36	.67
Other spray material	6.29	.0149	4.15	1.97	5.30	.0144	3.84	2.01	5.87	.0147	4.02	1.99
Seed					.24	.0007	.17	.09	.10	.0003	.07	.03
Gasoline and oil	1.14	.0027	.75	.36	1.04	.0028	.75	.40	1.10	.0028	.75	.37
Made-up box	61.17	.1453	40.32	19.15	53.33	.1453	38.58	20.24	57.83	.1453	39.61	19.57
Total material cost	87.22	.2072	57.49	27.31	74.11	.2019	53.61	28.13	81.63	.2051	55.92	27.62
Interest	45.15	.1073	29.76	14.13	45.00	.1226	32.56	17.08	45.09	.1133	30.89	15.26
Apple-building charge	4.21	.0100	2.77	1.32	3.67	.0100	2.66	1.39	3.98	.0100	2.73	1.35
Equipment charge	6.41	.0152	4.23	2.01	6.68	.0182	4.83	2.53	6.52	.0164	4.46	2.21
Sprayer hire	.85	.0020	.56	.27	.35	.0010	.25	.13	.64	.0016	.44	.22
Taxes	6.72	.0160	4.43	2.10	7.00	.0190	5.06	2.66	6.84	.0172	4.68	2.31
Insurance	.35	.0008	.23	.11	.50	.0014	.36	.19	.42	.0011	.29	.14
Water rent	.81	.0019	.53	.25	.92	.0025	.67	.35	.86	.0021	.59	.29
Total fixed cost	64.50	.1532	42.51	20.19	64.12	.1747	46.39	24.33	64.35	.1617	44.08	21.78
Total material and fixed costs	151.72	.3604	100.00	47.50	138.23	.3766	100.00	52.46	145.98	.3668	100.00	49.40

TABLE XLVIII.—*Summary of material and fixed costs for Yakima Valley (120 records).*

Material and fixed costs.	Clean-cultural management (75 records; 452 boxes).				Mulch-crop management (45 records; 398 boxes).				Combined management (120 records; 432 boxes).			
	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.	Cost.		Per cent of total material and fixed cost.	Per cent of total net cost of production.
	Per acre.	Per box.			Per acre.	Per box.			Per acre.	Per box.		
Manure	$7.82	$0.0173	3.90	2.15	$5.66	$0.0142	2.98	1.79	$7.01	$0.0162	3.56	2.03
Lime and sulphur	5.97	.0132	2.97	1.65	6.13	.0154	3.23	1.94	6.03	.0140	3.07	1.74
Lead arsenate (first spray)	1.68	.0037	.84	.46	1.81	.0046	.95	.57	1.73	.0040	.88	.50
Other spray material	4.50	.0100	2.24	1.24	4.38	0110	2.31	1.39	4.45	.0103	2.26	1.29
Seed	....	....	....	....	.33	0008	.17	.10	.12	.0003	.06	.03
Gasoline and oil	.85	.0019	.42	.23	.80	.0020	.42	.25	.83	.0019	.42	.24
Made-up box	65.68	.1453	32.73	18.07	57.83	.1453	30.45	18.31	62.77	.1453	31.92	18.16
Total material cost	86.50	.1914	43.10	23.80	76.94	.1933	40.51	24.35	82.94	.1920	42.17	23.99
Interest	86.68	.1918	43.19	23.85	85.87	.2158	45.22	27.18	86.37	.1999	43.91	24.98
Apple-building charge	4.52	.0100	2.25	1.24	3.98	.0100	2.10	1.26	4.32	.0100	2.20	1.25
Equipment charge	7.73	.0171	3.85	2.13	8.13	.0204	4.28	2.58	7.88	.0183	4.01	2.28
Sprayer hire	1.52	.0034	.76	.42	1.02	.0026	.54	.32	1.33	.0031	.68	.38
Taxes	11.12	.0246	5.54	3.06	10.75	.0270	5.66	3.40	10.98	.0254	5.58	3.18
Insurance	.75	.0016	.38	.21	.86	.0022	.45	.27	.79	.0018	.40	.23
Water rent	1.87	.0041	.93	.51	2.36	0059	1.24	.75	2.06	.0048	1.05	.60
Total fixed cost	114.19	.2526	56.90	31.42	112.97	.2839	59.49	35.76	113.73	.2633	57.83	32.90
Total material and fixed costs	200.69	.4440	100.00	55.22	189.91	.4772	100.00	60.11	196.67	.4553	100.00	56.89

MATERIAL COSTS.

The first item of material is the manure. As will be seen, the clean-cultural orchards applied the more manure. This is as would be expected, as the mulch-crop adds humus to the soil and manure usually is not needed so badly on those orchards as on the others. On the clean-cultural orchards 4 tons were applied per acre in North Yakima and 6.8 tons in Zillah, or 5.21 tons for the 75 clean-cultural orchards studied in the entire valley. On the mulch-crop orchards 3.38 tons were applied in North Yakima and 4.11 tons in Zillah, making an average of 3.77 tons per acre for the 45 mulch-crop orchards studied in the valley. If the mulch-crop and clean-cultural orchards are combined (120 records), there is found to be an average of 4.67 tons applied per acre. This manure is charged at the rate of $1.50 per ton for the entire district. There was, then, a cost of $7.01 per acre for manure for the entire Yakima Valley, or $0.0162 per box. The cost for the clean-cultural orchards was $7.82 and for the mulch crop $5.66 per acre.

The spray material is one of the principal items of material costs. This includes the lime-sulphur, arsenate of lead, and any other spray materials which are used. For all records, lime-sulphur, figured at the rate of $0.15 per gallon, cost $6.03 per acre, while other spray materials amounted to $6.18 per acre; thus all spray materials amounted to $12.21 per acre, or $0.0283 per box, making up 6.21 per cent of the material and fixed costs. The spray-material cost for the districts of North Yakima and Zillah is shown in Tables XLVI and XLVII.

Arsenate of lead paste had been charged at the rate of $0.09 per pound. Another item of material cost, amounting to very little in the total and appearing only on the mulch-crop orchards, is the seed used for mulch-crop. Usually this is clover, alfalfa, or sweet-clover seed, and is sown only occasionally. The annual charge for this amounts to but $0.33 per acre for the 45 mulch-crop records in the valley, or when distributed over the 120 orchards, including the clean-culture records, it amounts to but $0.12 per acre.

The gasoline and oil charge is used here in addition to the regular upkeep of the spray rig. This gasoline charge for all records in the valley amounted to $0.83 per acre, or $0.0019 per box. It is arrived at by allowing one pint per horsepower for each hour that the spray rig is used in the bearing orchard.

The cost of made-up box is $0.1453. This includes the shook, paper, nails, and the work of making it up, divided as follows:

Shook	$0.1050
Making up	.0065
Nails	.0056
Paper, including lining and wrapping	.0282
Total	$0.1453

The made-up box cost is 31.92 per cent of the material and fixed costs.

The total of all material and fixed costs is $82.94 per acre, or $0.1920 per box. For the 75 clean-cultural records it is $86.50 per acre, or $0.1914 per box, while for the mulch-crop it is $76.94 per acre, or $0.1933 per box. It is thus seen that the material cost per box varies but $0.0019 between the clean-cultural and mulch-crop systems of management.

FIXED COSTS.

The largest single item of fixed costs is the interest on apple-orchard investment. This charge is often a determining factor in the apple business. In the case of Zillah this cost amounts to $45.09 per acre, or $0.1133 per box, for the ranches studied, while in the case of North Yakima it amounts to $122.50 per acre, or $0.2652 per box. This difference is due to the difference in the bearing apple land valuation, which in Zillah is $563.57 per acre, while in North Yakima it is $1,513.25. For Zillah this interest charge makes 15.26 per cent of the total annual net cost of production, while in North Yakima it makes 31.44 per cent. Tables XLVI and XLVII show the difference in this cost between the mulch-crop and clean-cultural orchards. In Table XLVIII, where North Yakima and Zillah records are shown combined, there is found to be an acre cost of $86.37 or practically $0.20 per box for this interest charge, thus making up 24.98 per cent of the total annual net cost of production. Interest in this region is figured at the rate of 8 per cent.

Several growers have buildings devoted especially to apples, the charge for which appears in the ''apple-building charge.'' Usually these are inexpensive packing houses or sheds. The investment varies greatly, and in many cases where expensive packing houses or barns are on the place they are used for other purposes when not needed in handling the apple crop. It is therefore difficult to arrive at a proper investment charge for the apple orchard for such buildings. Such data and annual costs for this item as were secured were found to amount to practically $0.01 per box per year. In order that this figure might be comparable, the arbitrary figure of $0.01 per box for apple-building charge is used for records for the entire valley. This charge amounts to $4.32 per acre.

In arriving at the equipment charge, the average investment in equipment is determined and the amount chargeable to the apple orchard is arrived at by finding the percentage value that the apple orchard represents of the total land and improvement investment. This percentage value is figured on the equipment. That is, if the apple orchard represents 50 per cent of the land and improvement investment, 50 per cent of the equipment is charged to the apple orchard.

The equipment charge for the Zillah ranches was $6.52 per acre, while for those of North Yakima it was $9.07. The relatively higher cost for North Yakima is attributable to the fact that the farms there are small, necessitating a comparatively heavy equipment per acre. A 25 per cent annual charge was used for equipment in this region. This charge is divided as follows: 11 per cent, depreciation; 8 per cent, interest; 5 per cent, upkeep; 1 per cent, taxes.

This equipment charge is naturally more or less an arbitrary figure. It is impossible to tell just how much equipment is used on the orchard and just what percentage should be the equipment charge; also the equipment of many growers depreciates much more rapidly than that of others. Available data from this and other western apple-growing regions indicate that there is an average charge of fully 25 per cent for the equipment found on the average apple farm.

In addition to the regular equipment charge, there is another charge of like nature, namely, the spray rig hire. In many orchards of the valley those growers who do not have a rig have to hire their spraying done. This cost, when prorated over all records, amounted to $1.94 per acre for the North Yakima ranches and $0.64 per acre for those of Zillah, the difference reflecting the fact that a greater proportion of growers in North Yakima hired their spraying done than in Zillah. This charge is included under fixed costs, as it merely goes to make up the lack of equipment charge on those orchards which do not have a spray rig. Thus, for the 120 records, there is a spray rig hire of $1.33 per acre, or $0.0031 per box. If this regular equipment charge and spray rig hire are added together, forming what might be termed a total equipment charge, there is found to be an acre cost for all records of $9.21, or $0.0214 per box.

The land tax rate, as in many other Northwestern districts, is very high as compared to Eastern farming districts. For the farms studied in the North Yakima district it was $14.60 per acre, or $0.0316 per box, while for the Zillah district it was $6.84 per acre or $0.0172 per box. The high tax rate for North Yakima is due largely to the locality, much of the fruit being located on Nob Hill, where land has a high valuation due to its residential advantages. The cost of all taxes amounts to $10.98 per acre, or $0.0254 per box.

The water tax or rent is much higher in North Yakima than in Zillah, since many of the Zillah orchards are on the Konowak ditch and have free water right. The water rent amounted to $3.10 per acre for the North Yakima farms and $0.86 per acre for Zillah. The water rent for the 120 orchards was $2.06, or nearly $0.005 per box. As will be seen from Tables XLVI, XLVII and XLVIII, the water rent was higher in all cases in the mulch-crop orchards. This is not due to the orchards being in mulch crop, but to the fact that they happened to be situated in the more expensive irrigation districts.

There is an annual fire insurance on farm buildings, of which the apple orchard bears a part. This charge amounts to very little—$1.12 per acre for North Yakima, $0.42 per acre for Zillah, and $0.79 per acre, or $0.0018 per box, for all records.

All fixed costs amounted to $156.95 per acre for North Yakima and $64.35 per acre for Zillah, the great difference being due almost entirely to the high land valuation in North Yakima. As will be seen in Tables XLVI, XLVII, and XLVIII, the difference in this total fixed cost does not vary greatly with the system of soil management. For the 120 orchards considered in the valley the fixed costs per acre were $113.73, or $0.2633 per box. The total material and fixed costs for all orchards amounted to $241.08 per acre, or $0.5218 per box, for North Yakima, and $145.98 per acre, or $0.3668 per box, for Zillah. In the former case they make up 61.87 per cent of the total annual net cost of production, while in the latter case they make up 49.40 per cent.

For the 120 orchards studied in the valley there was a cost of $196.67 for material and fixed costs or expenses other than labor, or $0.4553 per box. This made up 56.89 per cent of the total annual net cost of production. It is evident that the crop determines the material cost to a certain degree, especially as regards the cost of made-up boxes, which depends directly on the yield. In the case of the fixed costs, though size of crop has no influence on the acre cost, there is a great saving in cost per box as the yield increases. That is, the fixed cost for a yield of 200 boxes is no less per acre than in the case of a yield of 400 boxes, but is twice the amount per box in the former as compared with the latter.

TOTAL OF ALL COSTS.

When the total of all costs for the 120 farms studied in the Yakima Valley is considered, there is found to be an annual acre cost of $345.68 per acre, or $0.8002 per box. This is figured on an average annual yield of 432 boxes per acre. The two groups of costs which go to make this up are the total net labor cost and the total material and fixed cost, or costs other than labor. The net labor cost is $0.3449 per box, or 43.11 per cent of the total net cost of production, the net maintenance making up 17.71 per cent, and the net handling cost 25.40 per cent. Material and fixed costs were $0.4553 per box, or 56.89 per cent of the total net cost, 23.99 per cent being material cost and 32.90 per cent fixed cost. The greatest item of fixed cost is the interest on investment, which made up 43.91 per cent of the cost other than labor and 24.98 per cent of the total net annual cost.

If the 120 orchards are separated into groups according to soil management, 75 under the clean-cultural system and 45 under the mulch-crop system, there is found to be a cost of $0.8041 per box for those under clean-cultural and $0.7939 per box for those under the mulch-crop system. Thus, in the case of these ranches, there appears to be little difference in the cost per box under the different systems. This is attributable to the yield being 54 boxes per acre higher in the case of the 75 orchards under the clean-cultural system than in the case of the 45 under the mulch-crop system. The net labor cost for the orchards studied under the clean-cultural system is $0.0434 more per box than those under the mulch-crop system. This difference is due in part to credit received from hay on orchards under mulch-crop management, and in part to the smaller cost of tillage in the mulched orchards. The material and fixed cost is more per box in the case of the mulch-crop orchards, as might be expected from the lower yield.

Table XLIX is a summary of all costs considered in the cost of producing apples on 120 farms in the Yakima Valley. For the 64 records in the North Yakima district there was a total net cost of $0.8434 per box, while for the 56 records in Zillah it was $0.7425 per box. The fixed cost for the North Yakima district was $156.95 per acre, or $0.3397 per box, or 40.28 per cent of the total of all net costs, while for Zillah the total fixed cost was $64.35 per acre, or $0.1617 per box, or 21.78 per cent of the total net cost. Thus the item of fixed costs is practically twice as great on the farms studied in the North Yakima region as on those about Zillah. This higher total net cost in the North Yakima district is due directly to the relatively higher land valuation. If interest on investment is not taken into account there is found to be an average annual net cost per acre of $259.31, or $0.6003 per box, for the 120 farms studied in the valley. In the case of North Yakima the net cost, minus interest, is $0.5782 per box, while in Zillah it is $0.6292 per box. In considering the correct total cost of production this interest should not be deducted, but included, as in the first part of the discussion. It is a legitimate charge necessary to present real cost. Often, however, the interest charge is not taken into consideration in presenting the cost of production, though it is one of the greatest factors bearing upon success or failure in the fruit industry. Counting interest on investment, the average annual net cost of production on these 120 farms representative of the Yakima Valley is $345.68 per acre, or $0.8002 per box. In Table L this total cost is subdivided to show the cost of the apples on the tree and the handling cost.

TABLE XLIX.—*Summary of all costs for Yakima Valley (120 records).*

District and character of cost.	Clean-cultural management (43 records; 475 boxes).			Mulch-crop management (21 records; 434 boxes).			Combined management (64 records; 462 boxes).		
	Cost.		Per cent of total net cost.	Cost.		Per cent of total net cost.	Cost.		Per cent of total net cost.
	Per acre.	Per box.		Per acre.	Per box.		Per acre.	Per box.	
North Yakima:									
Total net maintenance cost	$66.67	$0.1404	16.83	$44.22	$0.1019	11.76	$59.30	$0.1284	15.22
Total net handling cost	92.41	.1945	23.33	82.77	.1907	22.01	89.26	.1932	22.91
Total net labor cost	159.08	.3349	40.16	126.99	.2926	33.77	148.56	.3216	38.13
Total material cost	85.93	.1809	21.69	80.25	.1849	21.34	84.13	.1821	21.59
Total fixed cost	151.15	.3182	38.15	168.80	.3889	44.89	156.95	.3397	40.28
Total material and fixed costs	237.08	.4991	59.84	249.05	.5738	66.23	241.08	.5218	61.87
Total net cost of production	396.16	.8340	100.00	376.04	.8664	100.00	389.64	.8434	100.00
	(32 records; 421 boxes.)			(24 records; 367 boxes.)			(56 records; 398 boxes.)		
Zillah:									
Total net maintenance cost	$74.58	$0.1772	23.34	$48.49	$0.1321	18.41	$63.40	$0.1593	21.46
Total net handling cost	93.14	.2212	29.16	76.76	.2092	29.13	86.12	.2164	29.14
Total net labor cost	167.72	.3984	52.50	125.25	.3413	47.54	149.52	.3757	50.60
Total material cost	87.22	.2072	27.31	74.11	.2019	28.13	81.63	.2051	27.62
Total fixed cost	64.50	.1532	20.19	64.12	.1747	24.33	64.35	.1617	21.78
Total material and fixed costs	151.72	.3604	47.50	138.23	.3766	52.46	145.98	.3668	49.40
Total net cost of production	319.44	.7588	100.00	263.48	.7179	100.00	295.50	.7425	100.00
	(75 records; 452 boxes.)			(45 records; 398 boxes.)			(120 records; 432 boxes.)		
Yakima Valley:									
Total net maintenance cost	$70.03	$0.1549	19.27	$46.49	$0.1168	14.71	$61.22	$0.1417	17.71
Total net handling cost	92.72	.2052	25.51	79.56	.1999	25.18	87.79	.2032	25.40
Total net labor cost	162.75	.3601	44.78	126.05	.3167	39.89	149.01	.3449	43.11
Total material cost	86.50	.1914	23.80	76.94	.1933	24.35	82.94	.1920	23.99
Total fixed cost	114.19	.2526	31.42	112.97	.2839	35.76	113.73	.2633	32.90
Total material and fixed costs	200.69	.4440	55.22	189.91	.4772	60.11	196.67	.4553	56.89
Total net cost of production	363.44	.8041	100.00	315.96	.7939	100.00	345.68	.8002	100.00

TABLE L.—*Total cost of apples on the tree, handling cost, and the total cost per acre and per box.*

Character of cost.	North Yakima district (64 records; 462 boxes).		Zillah district (56 records; 398 boxes).		North Yakima and Zillah districts (120 records; 432 boxes).	
	Per acre.	Per box.	Per acre.	Per box.	Per acre.	Per box.
Net maintenance cost	$59.30	$0.1284	$63.40	$0.1593	$61.22	$0.1417
Material and fixed costs [1]	169.33	.3665	84.17	.2115	129.58	.3000
Net cost on the tree	228.63	.4949	147.57	.3708	190.80	.4417
Net handling cost	161.01	.3485	147.93	.3717	154.88	.3585
Total net cost	389.64	.8434	295.50	.7425	345.68	.8002

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[1] In this table the cost of made-up box and the apple-building charge are included in "net handling cost."

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